PAPERS

IN

MECHANICKS.

MECHANICKS.

The GOLD MEDAL of the Society was this session adjudged to Mr. GEORGE SMART, of the Ordnance Wharf, Westminster Bridge, in conformity to the Premium offered by them, Cl. 172, for CHIMNIES CLEANSED by MECHANICAL means, and in order to supersede the necessity of Climbing Boys, usually employed for the purpose.

The following ACCOUNTS and CERTIFICATES were received from him, and an ENGRAVING of the MACHINE employed by him to effect the purpose is hereunto annexed.

SIR,

IT is now nearly two years since I sent to the Society of Arts, &c. a machine for cleansing chimnies without the aid of climbing boys. I have since tried many other plans, such as joining

joining small ground rattans together with tubes, and the fastenings like that of a bayonet; but none have succeeded so well as the hollow tubes, with a cord passing through them, as hereafter described. One great improvement I have made in the brush, which now opens and shuts upon the principle of an umbrella, and shall send an improved machine, if the Society request it. I with this have sent a certificate, signed by a number of respectable housekeepers, for having cleansed by my machine three hundred and seventy-eight flues. My men have done some thousands, and I have six men and horses daily employed in it, which I mean to continue, until it is generally adopted by the master chimney-sweepers; many of whom, by the assistance of the Society for Improving the Condition of Climbing Boys, have now my machines in use in London, and most of the large towns in England;

and

Mr. G. Smarts Chimney Cleanser

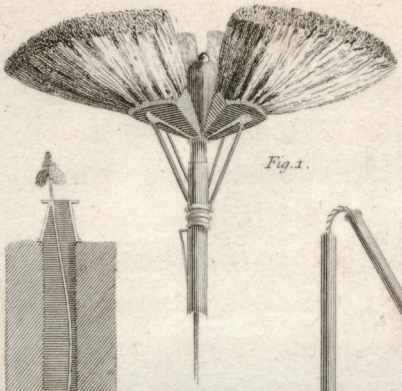


Fig. 1.

Fig. 2.

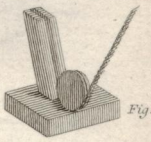


Fig. 6.

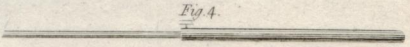


Fig. 4.

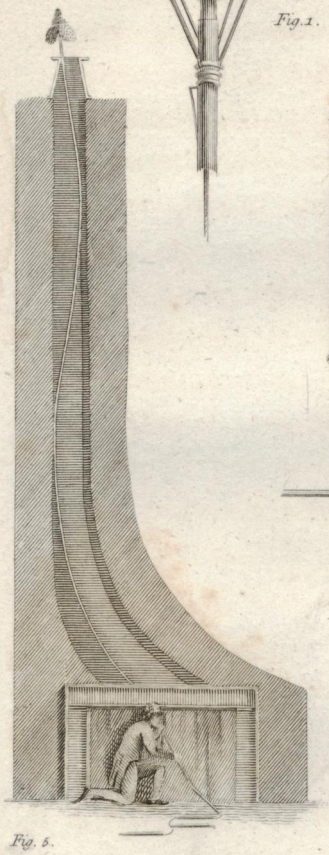


Fig. 5.

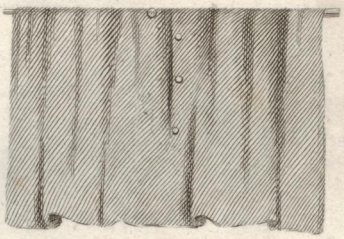


Fig. 3.

This plate is contributed by the Society for superseding the Necessity of climbing Boys by encouraging a new Method of sweeping Chimnies and for improving the Condition of Children and others employed by Chimney Sweepers.

and I hope, in time, will abolish the practice of children being sent up the chimnies. Some are so crooked that no machine will pass from the bottom, but they are few, about one in the hundred, these can be done with the same machine from the top; we have done a greater average number of narrow flues that no child could get up; others have been extinguished when on fire, by placing a wet cloth over the brush and putting it up the chimney.

I am, Sir,

Your most obedient servant,

GEORGE SMART.

Ordnance Wharf, Westminster-Bridge,
22d January, 1805.

CHARLES TAYLOR, Esq.

Description of Mr. Smart's Chimney Cleanser, and method of using it.—See Plate V.

The principal parts of the machine, are the brush, the rods for raising the brush,

brush, and the cord for connecting the whole.

Fig. I. and II. show the brush, consisting of four fan-shaped portions, connected by hinges so placed that the brush in ascending the chimney may lie close, taking up as little space as possible, and in descending may expand or spread out so as to occupy and sweep the sides of the flue; in drawing the machine down the chimney, the brush is prevented from contracting, by a contrivance exactly resembling what is used for umbrellas. *Fig.* I. represents the brush expanded; *Fig.* II. as contracted. The substance of which the brush is usually made, is called whisk, the article of which carpet brushes are formed; other substances may be substituted.

The rods which force up the brushes are hollow wooden tubes, with each a metal socket at the lower end; some of the sockets have a screw in them, for the

the purpose of confining the cord, and preventing, the rods from separating, as shown at A, *Fig.* II. The upper ends of the rods are now made without ferrules, and are somewhat taper, so as to allow a small motion within the sockets. Two feet and a half is found a very convenient length for each rod.

The cord runs from the top of the brush through all the rods, and, when drawn tight, keeps the whole of the machine together, so as to form one flexible rod throughout. Cordage manufactured at the School for the Indigent Blind, St. George's Fields, is well calculated for this purpose.

Fig. III. represents a cloth, to be placed before the chimney-piece, and hanging on a bar, which admits of being adjusted to different-sized openings.

Fig. IV. A bar composed of two pieces, one sliding out of the other (like a telescope slide), and furnished with a screw for fixing it at different lengths.

Three

Three of these bars make part of the apparatus belonging to the machine, one for fastening up the cloth (as in *Fig.* III.) is placed horizontally, and the other two upright, for closing the sides of the cloth to the jambs of the chimney-piece.

Fig. V. shows the machine raised up the chimney, with the operator working it, he being placed on the outside of the cloth.

Fig. VI. a part of the apparatus called the purchase, consisting of a small post and pulley fixed on a board, for the purpose of more easily drawing the cord tight before it is screwed down.

Method of using the Machine.

Having first ascertained, by looking up the chimney, what course the flue immediately takes, the cloth is then to be fixed to the chimney-piece, with the

the horizontal bar shown in *Fig.* III and IV. and the sides to be closed with two upright bars of the same sort.

The next part of the operation, is to introduce through the opening in the middle of the cloth *Fig.* III, the brush in its contracted form *Fig.* II; this opening should then be buttoned or tied up, to prevent the soot coming into the apartments; then the rods with the cord passing through them being laid in order upon the hearth, one of the rods is to be slided forward on the cord into the socket, on the lower end of that rod which supports the brush; the other rods are in like manner, one by one in succession, to be pressed up until the brush is raised somewhat above the top of the chimney, observing to keep the cord constantly tight; and when those rods which have a screw in the socket are brought up, they are to be placed on the purchase *Fig.* VI, when the cord is to be put round the pulley and drawn

very tight and screwed down; by which means all the rods above will be firmly connected together, and the whole may be considered as one long flexible rod.

When the operator thinks that the brush is near the top of the chimney, he should move it up and down, as he will then find the brush, if out, stop in returning on the top of the pot or chimney.

When it is known to be out, the machine is to be pulled down; in doing which the lower edges of the brush pressing against the top of the chimney, will cause it to expand, and there being a spring to prevent it from contracting again, it will sweep the soot down before it as it is drawing downwards.

The whisk being long and elastic, makes the brush capable of filling flues of different diameters.

In drawing down the machine, the person should grasp with his left hand and support the rod immediately above that

that which he is separating with his right hand, otherwise it may happen that those above loosen and slide down the cord, which will render the operation more difficult; the rods, as they are brought down, are to be laid carefully one by one with the cord within them, in as small a compass as they can conveniently be placed, that they may not dirt the apartments.

When the brush is quite down, it is to be shaken withinside the cloth, then the spring must be pushed, and the brush which was expanded, will contract like an umbrella into its original small space.

If, as it sometimes happens, there is a difficulty found in drawing down the brush when in the upper part of the chimney, the rods must be thrust up again somewhat higher, in order to alter the direction, and then be carefully drawn down.

It will be proper to let the cloth re-

main a short time up, where great cleanliness is required, in order to let the finer particles of soot subside within it.

For extinguishing a chimney on fire, a coarse cloth is to be tied over the brush, and dipped into water, then passed up as above directed.

When the machine has been laid by, the joints of the brush should be oiled before it be used.

One person is sufficient for performing the whole of the work with this machine; but it will be found more convenient to have an assistant to give up the rods to him who is using it, and to replace them on the ground when brought down.

It seems, from the great experience which now has been had with this machine, that about ninety-nine chimneys out of a hundred may be cleaned by it, and the remainder can probably be cleaned by some of the following means:

either,

either, First, by having a fixed apparatus at the top, with a chain descending down the flue and a brush annexed to it; Second, by getting to the top of the chimney, and letting down a rope and brush as practised in Edinburgh and other places; Third, by using the machine now recommended, by entering it at the top of the chimney, and forcing it downwards.

Certificates have been received by the Society from nearly one hundred housekeepers in London and its environs, whose chimnies have been swept by Mr. Smart's machines, and who have expressed their satisfaction at their execution of the work.

Although Mr. Smart is engaged in a very extensive line of business more beneficial to himself, yet for the sake of humanity, and in order to prevent the miseries attending children who fall

into the employment of common chimney-sweepers, he undertakes to provide persons to cleanse chimnies in his method, or will sell machines ready made for the purpose, at a moderate price.

The

The SILVER MEDAL and THIRTY GUINEAS were this Session voted to Mr. GILBERT GILPIN, of Old-Park Iron-works, near Shifnal, for his Improved CRANE and Flexible CHAINS.

The following COMMUNICATION was received from him; an explanatory ENGRAVING is annexed, and MODELS of the CRANE and CHAIN are reserved in the Society's Repository.

SIR,

HAVING discovered a method of working chains of the common construction, over pullies, in all directions, more safe and flexible than the best hempen ropes, and at the same time equally uniform, I have sent by the Shrewsbury waggon, for the inspection of the Society for the Encourage-

ment of Arts, Manufactures, and Commerce, a full-sized pulley in wood, and a piece of a chain, together with a model of a crane, exhibiting its manner of application.

From its simplicity of form, and facility of manufacture, the common chain, formed of oval links, has been in use from the earliest ages; and that it did not answer every purpose of a hempen rope in working over pullies, was not owing to its peculiar form, but from an error in the application.

Every chain of this nature has a twist in itself, arising from a depression given by the hammer to each link in the welding*; and this circumstance, so trifling in appearance, is not so in its effects, and it has in consequence a perpetual tendency (even when reefed perfectly straight in pullies, and on the

* The twist may be seen by holding the piece of the chain by one end, and viewing the links edgeways as it hangs down.

barrels

barrels of cranes) to assume a spiral form, which a plain cylindrical barrel, and the common pullies with semicircular grooves, are not in the least calculated to prevent. Hence the alternate links of the chain, in coiling round a barrel, or working over pullies, form obtuse angles in assuming the spiral form, bearing upon the lower parts of their circumferences, and forming as it were two levers, which wrench open and crush each other in proportion to the weight suspended, as well as prevent the freedom of motion in the links themselves, and thereby load the chain with additional friction.

A still greater obstruction to the uniformity of its motion, is the tendency which the chain has to make a double coil as it approaches the middle of the barrel and crosses its centre, and that of the pullies at right angles, by means of which the chain is frequently broken by the sudden jerk caused by the

the upper coil slipping off the undermost.

It is to these causes that all the accidents that occur to workmen and machinery from the failure of chains may be attributed (bad iron excepted), and which form the sole objection to their becoming a general substitute for ropes.

As a preventive to these evils, I have grooves cast in iron pullies, of sufficient dimensions to receive the lower circumferences of the links of the chain, which work vertically; those which work horizontally and form the gudgeon part of the chain (if we may be allowed the expression), bearing upon each side of the grooves.

The barrels are also of cast iron, with spiral grooves of the same dimensions, at such distance from each other as to admit the chain to bed without the danger of a double coil; by these means the links are retained at right angles

angles with each other, the only position for free and uniform motion.

The links of the chains are made as short as possible, for the purpose of increasing their flexibility, and they are reefed perfectly free from twist, in the pullies, and on the barrels, for the same reason.

When applied in blocks, the grooves in the pullies prevent the different falls of the chain from coming in contact, and render plates between them (as in the common way) totally unnecessary; the pullies are in consequence brought closer together, the angle of the fall from block to block considerably diminished, and the friction against the plates entirely avoided. Brass guards, with grooves opposite to those in the pullies, are riveted to the blocks, to prevent the chain getting out of its birth from any accidental circumstance. This method of working chains I first put in practice for Messrs. T. W. and B. Botfield, at these works, in July last; and

and it is applied in the working of cranes capable of purchasing from ten to fifteen tons; in the working of the governor balls of steam-engines constructed by Messrs. Boulton and Watt, and in the raising of coal and ore from the mines, for which purposes ropes had before been solely used at this manufactory. In all cases it has performed with the utmost safety, uniformity, and flexibility; so much so that the prejudices of our workmen against chains are entirely done away, and they hoist the heaviest articles with more ease, and as great confidence of safety as they would with the best ropes.

The same method is applicable, at a trifling expense, to all machines at present worked by ropes, or by chains, in the usual way: and all the common chains now in use, may be applied to it with equal facility.

With a view of ascertaining the relative flexibility of ropes and chains, I wedged

wedged an iron pulley, thirty-one and a half inches in diameter, on the spindle of the pinion of a crane of the following description, viz.

Barrel, 30 inches diameter;
Wheel, 64 teeth;
Pinion, 8 ditto;
Top block, with three pullies of 12 inches diameter;
Bottom block, with 2 ditto, ditto.

To the large pulley I attached a small rope, for the purpose of suspending the weights in the hoisting of the different loads, and the results were as follow:

The Crane was loaded with	Took to hoist the loads when reefed with theChain in grooved pullies*	Ditto, when reefed with a half-worn tarred strand-laid rope, 3½ inches in circumference	Ditto, when reefed with theChain promiscuously as in the common way
lbs.	*lbs.*	*lbs.*	*lbs.*
First ..2000	63	74	80
Second 1000	32	39	41
Third.. 500	17	21	22
Total..3500	112	134	143

* All the experiments were tried with the same grooved pullies.

The

The flexibility is inversely as these momenta, and proves the superiority of chains; for (on the average of the trials) with the chain in the grooves,

One pound raised	31,25 lbs.
With a half-worn strand-laid tarred rope, three inches and a half in circumference, - -	26,11 do.
And with the chain in the usual way, only	24,47 do.

It also appears (contrary to the general opinion), that chains are safer than ropes; for it is an established axiom, that those bodies whose fibres are most in the direction of the strain, are the least liable to be pulled asunder; and in our examination of the properties of a rope, we find that the strands cross the direction of the strain in undulated lines, and consequently prevent its uniform action thereon. A rope is subject to this inconvenience even when stretched in a direct line, but more particularly

ticularly so when bent over a pulley, as in that position the upper section moving through a greater space than the under one, is acted upon by the whole strain; and hence the frequent breaking of ropes in bending over pullies, from the double strain overloading the strands of which the upper section is formed.

The links of a chain are subject to the transverse strain, where they move in contact; but as such strain is in proportion to the length of the bearing, it must be very trifling. All the links having axles of their own, *the chain moves simultaneously with the strain, and both are in consequence retained in continual equilibrio.* A chain in grooves will therefore sustain as great a weight when bent over a pulley, as it will in a direct line, and consequently is safer than a rope.

A safe, uniform, and flexible method of applying chains in the working of machinery,

machinery, has long been a desideratum in the arts; for they are but little affected by exposure to the weather, or the heat of manufactories, whilst either produces the speedy destruction of ropes.

The discovery is of additional importance, as it substitutes a durable article for a very perishable one, and gives employment to our own manufactories at the expense of foreign importations.—The durability is at least six to one in favour of chains.

Though the model of the crane is chiefly intended to convey a proper idea of the new method of working chains, yet I trust it will be found to possess several other advantages in point of construction, which are entirely new, and calculated to increase the safety and durability, as well as to lessen the expense of that useful machine.

On reviewing the principles of a crane,

crane, we find that the gudgeons are the points of resistance to the machine and its load, and consequently the effect of the transverse strain upon the perpendicular, will be in proportion to the distance of the mortise for the gib from the upper one; and that of the oblique strain, in proportion to the distance of the mortise for the diagonal stay, from the lower one.

Notwithstanding these circumstances are so evident, they are seldom attended to; for in general a large and expensive piece of oak, sufficient of itself to make a crane of double the purchase, forms the perpendicular; the gib is mortised into it, at eighteen or twenty inches from the top, to make room for the gudgeon, as is the diagonal stay, at five or six feet from the bottom, to allow a birth below for the barrel. Thus the effect of the transverse and oblique strains of the gib and diagonal stay upon the perpendicular, is increased by

their distances from the gudgeons, or points of resistance, and the perpendicular itself considerably weakened by mortises made where the greatest strength is required. Hence the frequent failure of cranes of the common construction, by the breaking of the perpendiculars in the mortises.

It appears, however, that the various parts of a crane formed of wood, cannot be connected together in any other way than by mortising; and as this method *considerably diminishes the strength of the timber*, I make use of cast-iron mortise pieces.

The perpendicular is formed of two oak planks, each eighteen inches wide, four thick, and sixteen feet long; these, at the top and bottom, are let into cast-iron mortise pieces, which retain the planks ten inches asunder. The barrel for the chain, works between them. The piece at the top contains in the middle a dove-tailed mortise, into which a stock

stock for the gib is fixed; for greater security, an iron bolt goes through the whole; the stock projects two feet from the mortise, and a plank eighteen inches deep, and four thick, is bolted to each side of it to form the gib, the interstice between the planks forming a birth for the top block to slide in. The diagonal stay is of the same dimensions, formed in a similar manner, and connected to the perpendicular, by being let into the lower mortise piece.

In this mode of construction scarcely any part of the timber is cut away; and the strength of the materials, so far from being diminished, is augmented by the cast-iron mortise pieces, the gib is brought much closer to the upper gudgeon, and the centre lines of the perpendicular and the diagonal stay, crossing each other at the top of the lower one, places the whole strain as near as possible in a line with the gudgeons. The business of the perpendicular becomes

in consequence little more than that of a mere prop, and consequently requires no greater strength of materials than the diagonal stay.

The top block is made of cast iron, and has a groove three inches deep on each side, for the purpose of embracing the planks which form the gib.

To prevent the inconvenience of the dirt of the floor getting into the brass of the lower gudgeon, and thereby obstructing the revolution of the crane, those parts are reverse to the common way, the gudgeon being fixed in the floor, and the socket part which embraces it is cast in the bottom of the mortise-piece, as is also a channel to convey oil to the gudgeon.

I am, Sir,

Your most humble servant,

GILBERT GILPIN.

Old Park Iron-works, near Shifnal,
April 16th, 1804.

CHARLES TAYLOR, Esq.

Reference

Reference to Mr. Gilbert Gilpin's Crane, Pl. VI. *Fig.* 1, 2, 3, 4.

Fig. 1, Represents the crane with all its parts complete, ready for work.

A B, The perpendicular, formed of two oaken planks, each eighteen inches wide, four thick, and sixteen feet long, let into cast-iron mortise pieces C D.

E E, The barrel for the chain which works between the two planks of the perpendicular.

F, The top piece, containing in the middle a dove-tailed mortise, into which H, a stock for the gib, is fixed; an iron bolt goes through the whole, for greater security. The stock projects two feet from the mortise, and two planks I, K, eighteen inches deep, and four thick, are bolted one on each side of it, to form the gib, the interstices between these planks forming a

birth or space for the top block L to slide in. This block is made of cast iron, and has a groove three inches deep on each side.

M, The diagonal stay is of the same dimensions as the gib, formed in a similar manner, and connected to the perpendicular by being let into the lower mortise-piece D.

N, The handle or winch which turns a small pinion O, fixed on the same axis; this pinion works in the teeth of the wheel P, moving on the same axle as the barrel E, on which the chain R lies in spiral grooves.

S, The block and hook by which the goods are raised.

Fig. 2, Is a side view of the handle N, the pinion O the toothed wheel, and the barrel E placed betwixt the two uprights A B.

Fig. 3, Shows upon an enlarged scale part of the barrel E, and some of the chain lying in its proper position

Mr. Parker's Machine for Shoemakers.

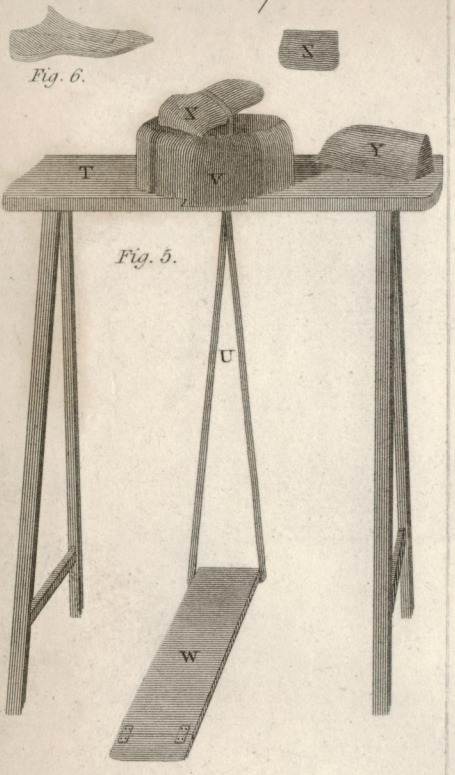


Fig. 6.

Fig. 5.

C. Varley del.

Mr. Gilbert Gilpin's Crane for raising Weights.

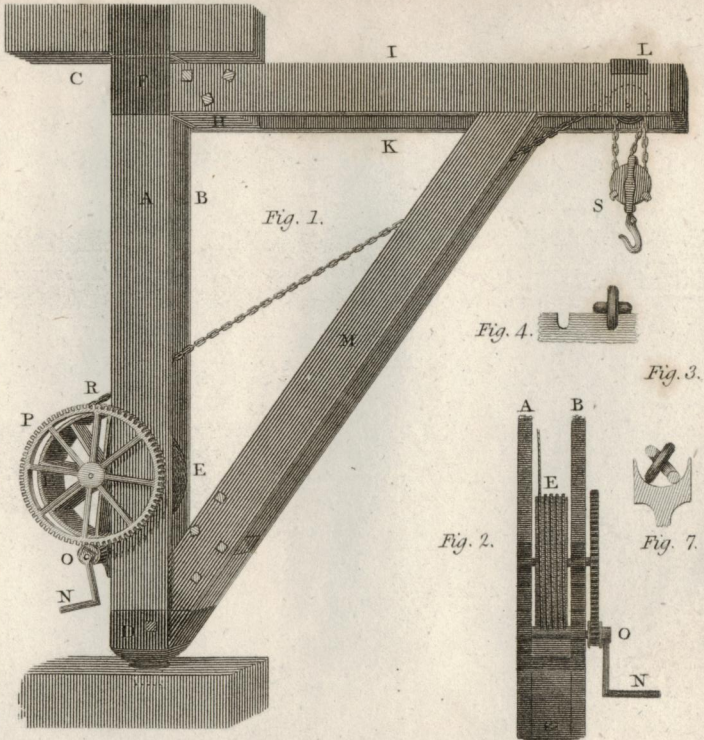


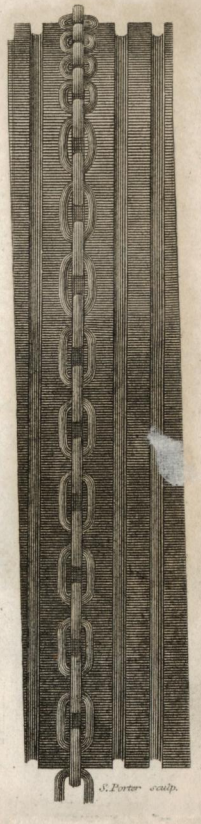
Fig. 1.

Fig. 4.

Fig. 3.

Fig. 2.

Fig. 7.



S. Porter sculp.

position in one of the spiral grooves, or channels: it is to be noted that the lower edge of one link lies in the groove, and the next link upon the surface of the barrel, and that by this means the chain is prevented from twisting in winding upon the barrel.

Fig. 4, Shows a section of part of the barrel E, in order to point out clearly the manner in which one link lies within it, the other link on its outside; it is contrasted by *Fig.* 7, the old method of working chains.

Certificates, dated November 22d, 1804, from Thomas Blackmore, John Swift, John Ball, Joseph Felton, Benjamin Heylehurst, Benjamin Hunt, and Thomas Hatchhess; who declare that they were present at the trial of the experiments above mentioned, that they had also seen the new method of working chains in daily use for upwards of

sixteen months, and are certain, that in that way chains work much more flexible than hempen ropes, and equally as safe and uniform.

Further certificates from Messrs. I. W. and B. Botfield, lessees of Old Park Iron-works, and Isaac Hawkins Browne, Esq. landlord of the said works, confirm Mr. Gilpin's statement; and further add, that the method is calculated for chains of all sizes, and for machinery of every description; that it is employed at their works with great success, in the working of cranes and mill machinery, and in the raising of coal and ore from the mines. That his chains applied in this manner are a complete substitute for ropes, and will prevent those fatal accidents which too frequently occur to the workmen and machinery, in the working of chains in the usual way. That Mr. Gilpin's crane is also constructed upon stronger and more durable principles than those in general use, and completely answers its purpose.

FIFTEEN GUINEAS were this Session voted to Mr. THOMAS PARKER, No. 6, Blue-Cross-street, Leicester Fields, for a MACHINE for the Use of SHOEMAKERS, to enable them to do their work in a standing posture.

An ENGRAVING of the MACHINE is hereunto annexed; one of the MACHINES is reserved in the Society's Repository; and the following COMMUNICATION was received from him.

GENTLEMEN,

CONVINCED of the utility of the bearer's invention, I trust I am guilty of no impropriety in recommending it to your serious attention, and, relying on your benevolence, I am persuaded, that if you see it in the light which I do, you will bestow on the inventor a suitable reward. It is needless for me to expatiate on the merit of the invention;

invention; I know that the inventor gets his living in my employment, and does all his work (which is in the branch of boot-making) at the bench he offers for your inspection. Dr. Buchan† describes its utility far better than I can pretend to explain it, and demonstrates how far the inventor ought to be encouraged. Here I beg leave to insert two quotations from his work, in page 49 of which he says, "Many of those who follow sedentary employments, are constantly in a bending posture, as shoemakers, tailors, cutlers, &c. Such a situation is extremely hurtful: a bending posture obstructs the vital motions, and of course must destroy the health; accordingly such artificers are generally complaining of indigestion, flatulencies, head-aches, pains of the breast, &c." and in page 50, he further adds, "A bending posture is likewise hurtful to the lungs; when this organ is compressed, the air cannot have free access to all its parts,

† Domestic Medicine, pp. 48, 49, and 50.

so as to expand them properly: here tubercles, adhesions, &c. are formed, which often end in consumptions; besides, the proper action of the lungs being absolutely necessary for making good the blood, when that organ fails, the humours soon become universally depraved, and the whole constitution grows weak."

I believe I have said all that is necessary on the subject, and beg leave to subscribe myself

Your most respectful
and obedient servant,
W. HEATHER.

9, Cockspur-street, Nov. 7th, 1804.

To the SOCIETY of ARTS, &c.

In consequence of the above letter, Mr. Thomas Parker, the inventor of the machine, was desired to attend with it upon a committee appointed by the Society,

ciety, on the 22d of November, 1804, and then informed them, that he had used this apparatus for twelve months past, and found it very useful. That all the work of shoe-making may be done therewith standing; but that in some parts thereof he finds an advantage in using along with it a high stool; and that before he used this machine, he never saw or heard of a similar invention; and that he has found it of great service to his health.

He stated the cost of such a machine to be about two guineas.

Reference to Mr. Parker's Machine for Shoemakers, Plate VI. *Fig.* 5, 6.

Fig. 5.—T. The bench standing on four legs, about four feet from the ground.

V. A circular cushion affixed to the bench, in the centre of which cushion

cushion is an open space quite through the bench, through which hole a leather strap U is brought up from below. This strap holds the work and last firm upon the cushion, in any position required, by means of the workman's foot placed upon the treadle W.

X, Shows the last upon the cushion, with the strap holding it firm.

Y, An implement used in closing boots.

Z, A small flat leather cushion, useful in adjusting the last and strap.

Fig. 6. The shoe-last shown separate from the cushion. The round cushion is formed of a circular piece of wood, covered with leather, and stuffed with wool or hair to give it some elasticity.

The SILVER MEDAL of the Society, and TEN GUINEAS, were this Session voted to Mr. ROBERT SALMON, of Woburn, for his GEOMETRICAL QUADRANT and STAFF.

The following COMMUNICATIONS were received from him, and an explanatory ENGRAVING is annexed.

The Instruments are preserved in the Society's Repository, for the inspection of the public.

SIR,

HEREWITH you will receive my quadrant and explanation of the same. I have also sent the staff, which I presume may be useful for the purpose of trying any experiment. On the staff, I beg leave to point out an improvement which I made, and have had in use for some years; it is the screw at the

the bottom, which I have never seen applied but to my own cross staffs. By means of this screw, the staff may be readily fixed in the ground, in a manner that it could not be without it, nor could the instrument be used without such screw.

I am, Sir,

Your obedient servant,

ROBERT SALMON.

Woburn, March 20th, 1803.

CHARLES TAYLOR, Esq.

Description and manner of using Mr. Robert Salmon's Geometrical Plotting Quadrant, Level and Calculator, for the use of Navigation and Land-Surveying; ascertaining inaccessible distances, and for demonstrating and determining various Problems in Geometry and Trigonometry, Plate VII.

On the instrument and parts thereof, are engraved the names given by the inventor,

inventor, and made use of in these explanations; the *base* line being that at right angles with the 90 degrees on the *arch*, as it is also to the *perpendicular*, which perpendicular always moves parallel to the 90 degrees. For the use of land-surveying, where the instrument can be made stationary, the sight (marked *a*, *Fig.* 1, *Pl.* VII.) with the small hole in it, must be applied; but for sea-service, the one *b*, *Fig.* 2, with the mirror, must be substituted in its place.

Every person who has had occasion to describe or calculate the parts of the right-lined figures used in geometry, perspective, surveying, navigation, dialing, architecture, &c. &c. must have perceived, that all of them are resolvable into the most simple of figures, a *triangle*, or some number of them.

Hence the great importance of geometry and trigonometry, in teaching, either by construction or calculation, the knowledge of all the properties or relations

Mr. R. Salmon's Geometrical Quadrant & Staff.

Fig. 1.

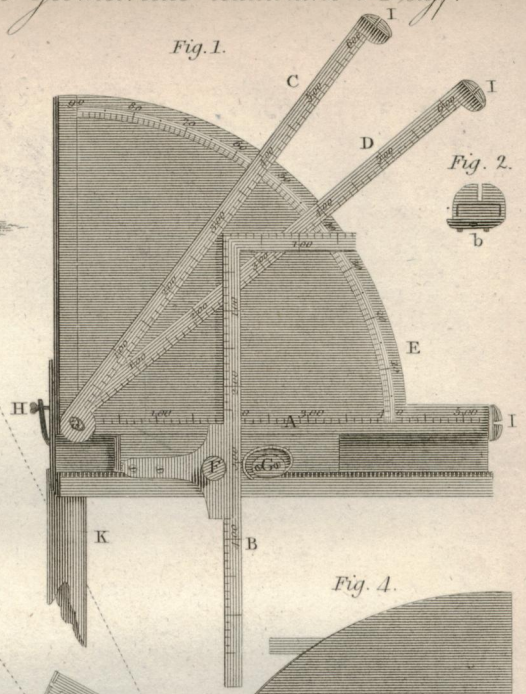


Fig. 2.

Fig. 3.

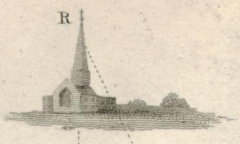
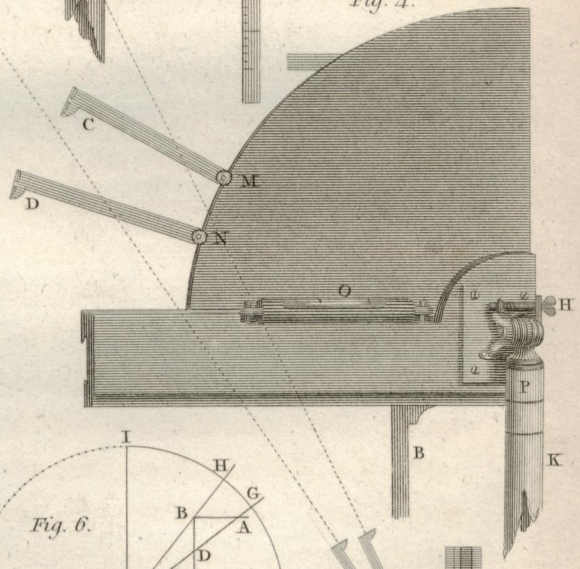


Fig. 5.

Fig. 4.



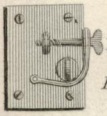
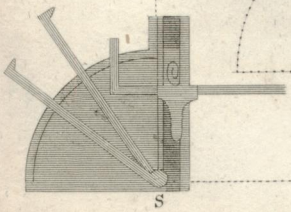
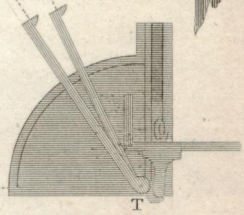


Fig. 7.

Fig. 6.





C. Varley del.

S. Porter sculp.

relations between the three sides and three angles, of which every plane triangle is composed. Euclid having demonstrated, in the fourth proposition of the sixth book of his Elements, that in any two *similar triangles* (by which he means their having the same angles, without regard to the actual lengths of their sides, for one triangle may be very small and the other ever so large) every pair of the corresponding sides in the two triangles are proportional; it is the business of trigonometry to solve such problems, with the help of the tables of sines and tangents, or of sectors, sliding or other rules, and scales, by which you can find, on inspection, a *right-angled* triangle, exactly similar to any given right-angled triangle, (or having one of its angles equal to 90°) which can be proposed, or can occur in practice; and by the Rule of Three we say, *as* any side of the tabular triangle *is to* the similar side, supposed to be known, of the triangle under consider-

ation, *so is* any other side of the same tabular triangle, *to* the corresponding side supposed to be sought, of the triangle in question. It is evident, that by means of the *base-line*, *perpendicular*, and either the *upper*, or *lower limb* of my instrument, by the two motions of which the *perpendicular* is capable, and the angular motion of which the *limbs* are capable; any right-angled triangle whatsoever, as C B E, or C D E, in the diagram *Fig.* 6, *Pl.* VII. may be instantly formed, (by bringing the top corner of the *perpendicular* to touch the *limb*) with the same or greater facility, than it could be taken out of a trigonometrical table, measured by the compasses on the sector, or set on any instrument now in use for that purpose. But no instrument that I have seen or read of, is capable of forming immediately, *any obtuse-angled triangle*, as on my *geometrical plotting quadrant* can be done; nor can the trigonometrical tables be applied, to produce the sides and angles of such a triangle

triangle without some trouble in any case; and in some of the most useful cases in practice, the labour is very considerable. I shall therefore give the solution of five problems. First, supposing, that *Figure* 6, *Pl.* VII. represents my instrument, set to answer this and the following problems; A, B, C, being the triangle under consideration; then since the ∠ A C E, is by Euclid (I. 20) equal to the ∠ B A C, it is evident that this angle will be shown, or may be set, by means of the divisions on the arc F G; also, that since C B E, and I C B, are also equal, the *arc* H I, with the addition of 90° (for the angle E B A), will show the ∠ C B A, of the triangle; it is equally evident, that the *arc* F H will show the sum of the two ∠s B C A, and A C F, at the same time that the lengths of all the sides may be read off, on the divisions or scales, on C A, C B, and B A. Therefore:

FIRST.—*To construct or set a triangle, having two of its angles and the side between them given.*

Set the limb C G, to the division at G upon the *arc* answering to one of the angles, say A, and make it fast, then to this ∠A add the other given angle, (which we will call C) and set *the other limb* C H, and make it fast at the division H, on the arc answering to the sum of their degrees; then on the *limb* C G, seek the length of the given side C A; next, push the *perpendicular* up or down, till the *parallel* cuts the point A, (always observing, the divided edges are those you work to), and by the help of the mill-headed *nut*, move the *perpendicular*, till its top corner just touches the *limb* C H, say in the point B; when it is evident that the degrees on the arc H I, added to 90°, is equal to the angle B, and that the other sides C B, and B A, may be read off thereon. Or supposing C B D to be the triangle, whose

whose angles B and C and side B C are given, we have only to move the *limbs* so as to make I H equal to B, and H G equal to C, and then to bring the top of the *perpendicular* to touch C H, at the division B, answering to the side C B, when the other ∠ D will be shown by the division on the *arc* G F, adding 90° thereto and; the remaining sides C D and B D may be read off on their respective scales.

SECOND.—*To set a triangle, having two sides and the angle included between them given.*

Let A B C be the triangle, A B and A C the given sides, and A the given angle; first set the *limb* C G to the division answering to A, then bring the *parallel* up to the point A, answering to the side C A, and by the *nut* move the *perpendicular*, till B A answers to the given side B A; next bring down the *limb* C H to touch B, and on C B may be read the other side, while H G

will show the angle C, and I H + 90° the ∠ B, whence all the six parts are known.

THIRD.—*To set a triangle, having two sides and an angle opposite to one of them given.*

Let A B C be the triangle, A C and C B the given sides, and A the given angle; first read the angle A on F G, and set the *limb* C G thereto; then push up the *parallel* to the division at A, answering to C A, and with one hand work the *nut* and with the other move the *limb* C H, till they touch at B, the division answering to the side C B; then B A is the side sought, and the arc G H will show the ∠ C, and I H + 90° the ∠ B.

FOURTH.—*To set a triangle, having two angles, and a side opposite to one of them given.*

Let A B C be the triangle, A and C the given angles, and B A the given side; first, set F G to the ∠ A, and G H to

H to the ∠ C, then push the *perpendicular* up or down with one hand, while the other works the *nut*, till the given side B A, on the *parallel*, is applied exactly between the *limbs* C H, and C G, then I H + 90° will show the remaining angle B, and on C B, and C A, may be read the lengths of those sides.

FIFTH.—*To set a triangle, whose three sides are given.*

Let A B C be the triangle; on the *limb* C H seek the point B, answering to the side C B; then, using one hand to move the *perpendicular*, and the other to turn the *nut*, let an assistant at the same time, with his right hand, gently move the *limb* C H, while you cause the top corner of the *perpendicular* always to touch the point B; at the same time let the assistant move the *limb* C G with his left hand, till the lengths of C A, and B A, on their respective scales, are found to intersect each other,

when F G will show the ∠ A, G H the ∠ C, and H I + 90° the ∠ B.

My solution to the last problem, is inferior to the common method of plotting the triangle on paper, and measuring the angles with a protractor; but I have introduced it here, to show that my instrument is capable of solving this, as well as all other cases of obtuse-angled triangles, and might, by extending the *arc* to a semicircle, as shown by the dotted lines on the figure, solve any triangle. In the practical problems in surveying, which follow, the triangles can always be taken right or obtuse angled, and the instrument as at present constructed is fully competent. I might here add, that a given line can readily by my instrument be divided into any number of equal parts; drawings might be enlarged or diminished, as readily as with the proportional compasses, and many other equally useful purposes may be effected thereby.

FIRST.—

FIRST.—*To measure an inaccessible distance, by a perpendicular line set off towards the right hand, from the line or base between the observer and object.*

Set the *base-line* of the instrument, in a line pointing to the object, at the same time place a staff at any distance at pleasure, as a perpendicular (being 90 degrees from the base). On this perpendicular measure any distance (say 50 yards or other measures) as a second station; move the instrument to this distance, and place it with its *perpendicular* in the same line as before; the instrument being so placed, set the *lower-limb* pointing to the object, and with the screw make the same fast; this done, the distance of the object will be thus readily known. Raise the moving *perpendicular* of the instrument to the division 50 (as before suggested), then with this height move the same by means of the *nut*, till the extremity intersects exactly the *lower-limb* before set,

set, at which intersection, the distance from the second station will be shown; and on the *base-line* will also at the same time be seen the distance from the first station: this is a case of right-angled triangles.

Note.—As the divisions on the *perpendicular* are denominated (either feet, yards, poles, or other measures), so will the distances be indicated on the other *limbs*, and on the *base* of the instrument.

SECONDLY.—*To determine the distances of any two inaccessible objects, both objects lying in a right line from the observer.*

As before directed, place the instrument with its *base* in the line of the objects; then by means of the *upper-limb* set at 90 degrees, place a staff as a perpendicular at any distance at pleasure (say 50 as before). This done, remove the instrument to this second station, and place it so that the *upper-limb* (still

(still at 90°) may be in the same line as when at the first station; this done, move the *upper-limb* into the direction of the nearest, and the *lower-limb* into the direction of the most distant object; which *limbs* being so set, and made fast, the distance of both objects from the second station will be seen on the two *limbs*, and the distance from the first station at the same time seen on the *base-line*, by setting and moving the *perpendicular* as directed in the last case. This is also a case of right-angled triangles.

THIRDLY.—*To measure an inaccessible distance in an oblique angle, where a right angle cannot be obtained, by reason of some impediment on the ground.*

At the first station, from which the distance is required, place the instrument; then set up a staff in any attainable direction, to any distance at pleasure (the more distant the better). The instrument being set, with its *base* in

in direction to the staff, with one of the moving *limbs* take the angle of the object, and with the screw fix it thereto. This done, move the instrument in the direction of its base (being between the first station and staff set up) to any certain distance, (say 50 yards or measures) as a second station. From this second station again take the angle of the object, and thereto fix the other moving limb; this done, the distance both from first and second station, as also the bases and perpendiculars thereto will thus readily be seen. Set the *perpendicular* at random to any height, move the same till the upper point intersect the *upper limb*, or that most distant from the *base*, then read off on the *parallel*, the divisions parallel to the base subtended between the two *hypothenuses* or *limbs;* if this distance or division be equal to the distance measured on the base line, (*i. e.* 50) then the distance of the object from both stations

stations will be shown on the two *limbs*, as will also the base and perpendicular on the respective lines. If the divisions on the *parallel* do not agree with the distance measured, the *perpendicular* must be altered till that division be shown, when the required distance will be given. This is a case of our first problem.

FOURTHLY.—*To level, or measure the altitude of any object.*

It is only necessary to set the plane of the instrument vertical, instead of horizontal, by means of the joint under the instrument, whence it is evident every case may be known as on the horizon; and to level, it is only requisite to set the *spirit level* at the back of the instrument, the *base-line* and every object cut by the same will be level thereto.

FIFTHLY.—*To take angles or altitudes at sea, where the instrument cannot be made stationary.*

For this purpose, it is first requisite to change the *sight* a, *Fig.* 1, and substitute

tute the one b, *Fig.* 2; which being firmly fixed and adjusted at right angles with the upper-limb, it is evident that when by reflection any object be brought to coincide on the *mirror*, at the extremity of the *base-line*, with another object seen in the direction of such *base*, the angle will then be known, being double what the upper-limb denotes on the *arch*, to which true angle, or its double, the *lower-limb* may be fixed, leaving the one with the *mirror*, again at liberty to take another observation and angle, at any distant place, or time; which being so taken, this *limb* may be also moved and fixed, to double its apparent angle, and the altitude or distance be then determined, by setting the *perpendicular* and *parallel* as in other common cases on land.

From this mode of determining distances, as the use of calculations and of tables of sines and tangents are superseded, it is presumed that much convenience will arise to the unlettered who

who may have occasion to use it, and thereby the errors of calculations will be avoided.

As well as the before-mentioned purposes to which the instrument applies, it is presumed there will be found other things which it will perform, some it is hoped useful, and some amusing, amongst which may be enumerated, Multiplication, Division, Rule of Three, Double Rule of Three, &c.; determining the area or sides of any sort of triangle from any proper data; determining the inscribing or inscribed circle of any triangle, square, or polygon, showing a mean proportional between two numbers, &c.

It is presumed, that an instrument, if perfectly made, on a large scale, would be found very useful and accurate in various practical calculations, as well for making them, as for proving them after made in figures.

The following are specimens of the manner of calculating by this instrument.

FIRST QUESTION.—*If* £100 *in* 12 *months produce* 80 *shillings interest, what will* £200 *produce in* 18 *months, and also what will it produce in* 12 *months?*

On the *base-line* of the instrument set £100. On the *perpendicular* set 80 for shillings interest. Then bring the *lower-limb* to intersect, which angle will then be, as per question, equal to 12 months at all places on the *base;* having so fixed the *lower-limb,* move forward the *perpendicular* till it intersect the *lower-limb* at the height 12 on the *perpendicular,* then raise the *perpendicular* to 18, and to the extremity thereof fix the *upper-limb* to intersect, which angle will then be in proportion as 18 to 12 to the *lower-limb,* being equal to the different times. The limbs being so fixed, it is only requisite to move the *perpendicular* to 200 on the *base;* and, raising the *perpendicular* till it intersect the upper-limb, you will have thereon the answer 240 shillings, and

and at the same time, at the intersection on the lower limb 160, being the interest for 12 months only.

QUESTION SECOND.—*To determine the inscribed or inscribing circle of any polygon, the side being given; for example, the hexagon whose side is* 100 *feet.*

Set one of the limbs to half the angle included in the required side of the hexagon (*i. e.* 30 degrees), then set the *perpendicular* to the height of half the side given, being as per question 50. Then move the *perpendicular* till the extremity intersect the *limb* before set, on which at such intersection, will be denoted the radius of the inscribing circle, and at the same time may be seen on the *base* the radius of the inscribed circle.

QUESTION THIRD.—*To find a mean proportional between* 600 *and* 200.

This depends on the well-known property of a right-angled triangle.

Set the *perpendicular* on the *base* line, at the distance of half of the

difference of the two numbers (*i. e.* $\frac{600 - 200}{2}$); this done, raise the *perpendicular*, and move either of the *limbs* till the extremity of the *perpendicular* intersect thereon at half the sum of the numbers, being 400. This done, the height of the *perpendicular* will show the proportional required, being 347.

Note.—On the plate in which the perpendicular slides, will be found Nonius's for subdividing the divisions on the base or perpendicular, into 10 divisions.

Reference to the Engraving of Mr. Salmon's Geometrical Quadrant and Staff, Plate VII.

Fig. I. represents the face of the quadrant, on which A is the fixed base line; B the moveable perpendicular; C the upper limb; D the lower limb; E the arc; F the nut, which moves the perpendicular by means of a rack and pinion.

G, a spring to keep the perpendicular steady; H, a screw for fixing the joint of the staff; *a* the eye-piece, or sight, with a small hole in its centre; I, I, I, the sights for direct vision, consisting of only a small slit in each. When objects are to be viewed by reflection, as with a Hadley's quadrant; the sight *a* at the centre is taken off, and the sight *b* with a mirror, shown at *Fig.* II. on rather a larger scale than the former, must be substituted.

Fig. III.—K is the staff, the mode of applying which to support the instrument when in use, is shown by the same letters in the other figures; L is the screw, by which the staff is fixed firm in the ground.

Fig. IV. represents the back of the quadrant; M M are the screws, by which the upper and lower limbs are fastened after taking an observation.

O, a spirit-level; H the tightening screw for the joint before noticed; P the socket attached by its joint and

tightening screw to the back of the quadrant; the staff K is screwed into the above socket.

Fig. V. shows the practical method of using the instrument for determining the distances of the objects Q and R from the two stations S and T, at which the instrument is to be successively placed, and used as before described.

Fig. VI. is the diagram referred to at page 294.

Fig. VII. represents the mode of applying the tightening screw H, in *Fig.* I. and IV. by means of the semicircular spring, enclosing the cylindrical stem, or neck of the joint.

TEN GUINEAS were this Session voted to Mr. PETER HERBERT, No. 33, Bow-street, Covent-garden, for an improved BOOK-CASE BOLT.

The following COMMUNICATION was received from him. A Drawing of the Bolt is annexed, and a Model is reserved in the Society's Repository.

SIR,

I HAVE taken the liberty of laying before the Society a model of my invention, which I hope is sufficient to explain my intention. I intended it for a library book-case bolt, to facilitate the opening of both doors at once, and to secure the same, without the trouble of bolting two bolts in the common way. It will do for wardrobes, French casements, or folding sash doors. It will also make a good sash fastening,

if let into the bottom sash, with a small brass knob to slide as common; it would bolt in the frame by the side of the sash cord, both sides at once. I can also make it to answer sundry other useful purposes if required.

I remain, Sir,

Your obedient humble servant,

PETER HERBERT.

No. 33, Bow-street, Covent-garden,
Dec. 31st, 1804.

To CHARLES TAYLOR, Esq.

Reference to the Engraving of Mr. Peter Herbert's Book-case Bolt, Plate VIII. *Fig.* 3, 4.

K L, *Fig.* 3, represents the two stiles of the doors of a folding book-case.

M, the key-hole of a lock with two bolts, which are more clearly shown at *Fig.* 4, where the back of the lock N shows the two bolts of the lock pressing back

Mr. Peter Herbert's Book Case Bolt.

Fig. 3.

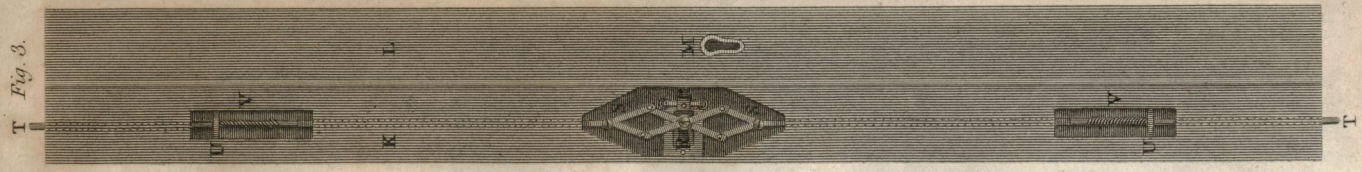


Fig. 4.

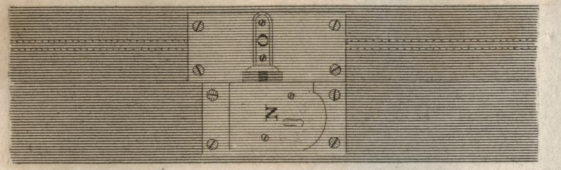
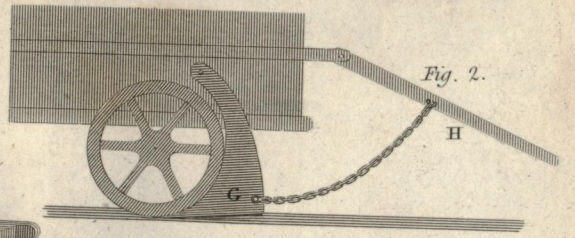


Fig. 2.



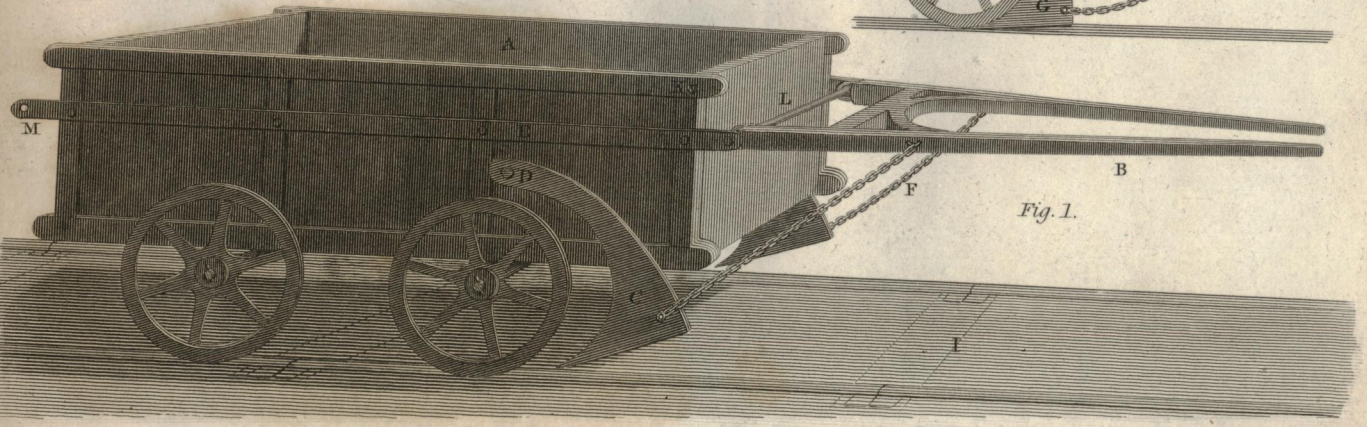


Fig. 1.

C. Varley del.

Mr. Le Caan's Check to Carriage Wheels.

S. Porter sculp.

back a sliding-piece O; on the front part of this sliding-piece in *Fig.* 3, two small friction rollers are placed at P, in the act of pressing against two levers, crossing on one common fulcrum R, to each end of which, shorter levers S S above and below are connected by joints. These short levers act upon two long bolts, whose extremities are shown at T T, having each a helical spring at V V. In the state as engraved, the doors are locked and bolted.

On drawing back the bolts of the lock by means of the key, the helical springs, V V, press against the plates U U, through which the long bolts pass; they force back the long bolts and sliding-piece O, and allow both the doors to open.

TEN GUINEAS were this Session voted to Mr. CHARLES LE CAAN, of Llanelly, in Carmarthenshire, for his Invention of a CHECK to CARRIAGE-WHEELS on Rail-roads.

An Engraving of the STOP or CHECK is hereunto annexed, and the following COMMUNICATIONS were received from him.

A Model of this Invention is reserved in the Society's Repository, for the inspection of the public.

GENTLEMEN,

THE utility arising from the conveyance of heavy bodies, on tram or rail roads, daily demonstrates their superior excellency over any other method as yet adopted.

I have, gentlemen, viewed its operation in different quarters of the kingdom,

dom, and have witnessed several serious accidents, for the want of some useful instrument to assist the horse whenever he may be overpowered by pressure, or fall by accident. To perfect so desirable a mode of conveyance, I have turned my thoughts to this subject, and I beg leave to submit to you a drawing of my invention, which from its simplicity I flatter myself will convince you of its value, and may no doubt, with a little variation, be united to carriages in general, and become of public utility.

I am, Gentlemen,

Most respectfully,

Your obedient humble servant,

CHARLES LE CAAN.

At Garraway's Coffee-house,
or Llanelly, Carmarthenshire, April 4th, 1805.

To the SOCIETY for the
ENCOURAGEMENT of ARTS, &c.

GEN-

GENTLEMEN,

THE model of a rail-road waggon and check or stop, which I have this day the honour of presenting to you, I trust on examination will be found to possess the means of preventing those various accidents which have from time to time proved fatal to the horses employed in such service, particularly where the declivity is from twelve to sixteen inches to the chain, and the trade on such road principally descending.

The use of a horse employed on a rail-road is as frequently to check the velocity of a waggon or waggons loaded, (generally to the weight of two tons and a half each) so as that they may not exceed a certain degree of motion, as well as to draw them on such parts of the road as approach near upon, or quite to a level. When the horse finds himself

himself pressed upon beyond his power of resistance; to relieve himself, he is compelled to quicken his pace, by which means the velocity of the waggon exceeds any government during the continuance of the declivity, which gave it such action: under such circumstances, the least trip of the horse terminates in a fall, by which, from the formation of a rail or tram road, the animal becomes injured, notwithstanding every manual exertion. For the preservation of that valuable animal, and as a preventive to all such accidents in future, I turned my thoughts to the invention of the simple check or stop now before you, and which may be appropriated to carriages in general use.

As the utility of rail-roads daily increases in the opinion of the public, I trust every invention that may perfect such a system, will add in some degree to its value, and aid in its advancement

to

to perfection, an object so desirable as the conveyance of every species of merchandise, and so requisite in a commercial country.

I am, Gentlemen,
Your very obedient humble servant,
CHARLES LE CAAN.

Llanelly, Carmarthenshire, April 11th, 1805.

To the SOCIETY of ARTS, &c. Adelphi.

Reference to the Engraving of Mr. Le Caan's Check or Stop, for Carriages on Rail-roads, Plate VIII. *Fig.* 1, 2.

Fig. 1.—A. A rail-road waggon.

B. The shafts in the direction as when drawn by a horse.

C C. The checks or stops made of oak, and shod with strong plate-iron; these checks should always be made somewhat thicker than the wheels.

D. A

D. A bolt and nut on which the stop C hangs: it is here fixed to the side of the cart, but it will be better for this bolt and nut, to pass through the iron bar E, to which the shafts are connected, and the stop to hang from thence.

F. Chains which keep the checks suspended whilst the horse is drawing, but at such a distance from the wheels, as to permit the checks to assume the position G, in *Fig.* 2, when the shafts are inclined as at H, in consequence of the horse falling from pressure or accident; in which case, the waggon instantly stops, and prevents the horse from receiving any material injury, which the momentum of two or more waggons, arising from their velocity on roads upon an inclined plane as I, *Fig.* 1, has unfortunately frequently occasioned.

It is necessary to observe, that to prevent the great trouble which would arise

arise from turning the waggon round on a rail-road, it would be better to have a check to each of the four wheels; in which case, after the waggon has discharged its load at the place of its destination, the chains F F may be loosened from the shafts, and fastened upon hooks, one of which is shown at K, so as to keep the checks suspended above the road; the iron bar L, which attaches the shafts B to the body of the waggon, is then to be removed, and with the shafts to be placed in a similar manner at M on the other end of the waggon, which now becomes the fore part, the horse drawing it back to be again loaded. Whenever the waggon is ascending, the checks behind the waggon may occasionally be let down, and used as rests to relieve the horse when necessary.

The SILVER MEDAL and TEN GUINEAS were this Session voted to Mr. JOSEPH DAVIS, No. 14, Crescent, Kingsland Road, for his Invention of a DAY and NIGHT TELEGRAPH; from whom the following Communications were received.

An explanatory Engraving is annexed, and a Model of the TELEGRAPH is preserved in the Society's Repository.

SIR,

I TAKE the liberty of troubling you with a model of a Day and Night Telegraph of my own invention, which I shall be obliged by your submitting to the inspection of the gentlemen of the Society of Arts, &c. Permit me to to observe, that the day telegraph works on a superior principle to that at present in use; it is not so liable to get out

out of order, and at the same time facilitates the correspondence. The night telegraph can at any time (if out of use) be got ready and fixed in a few minutes; the principle of this telegraph will admit lights of any description, simple or compound, which are not liable to injury from the weather; the situation in which they are placed with the line of direction, (in my opinion) makes the night telegraph equally useful with the day telegraph. The line of direction which I have applied has several new properties peculiarly advantageous to night telegraphs.

I am, Sir,

Your obedient humble servant,

JOSEPH DAVIS.

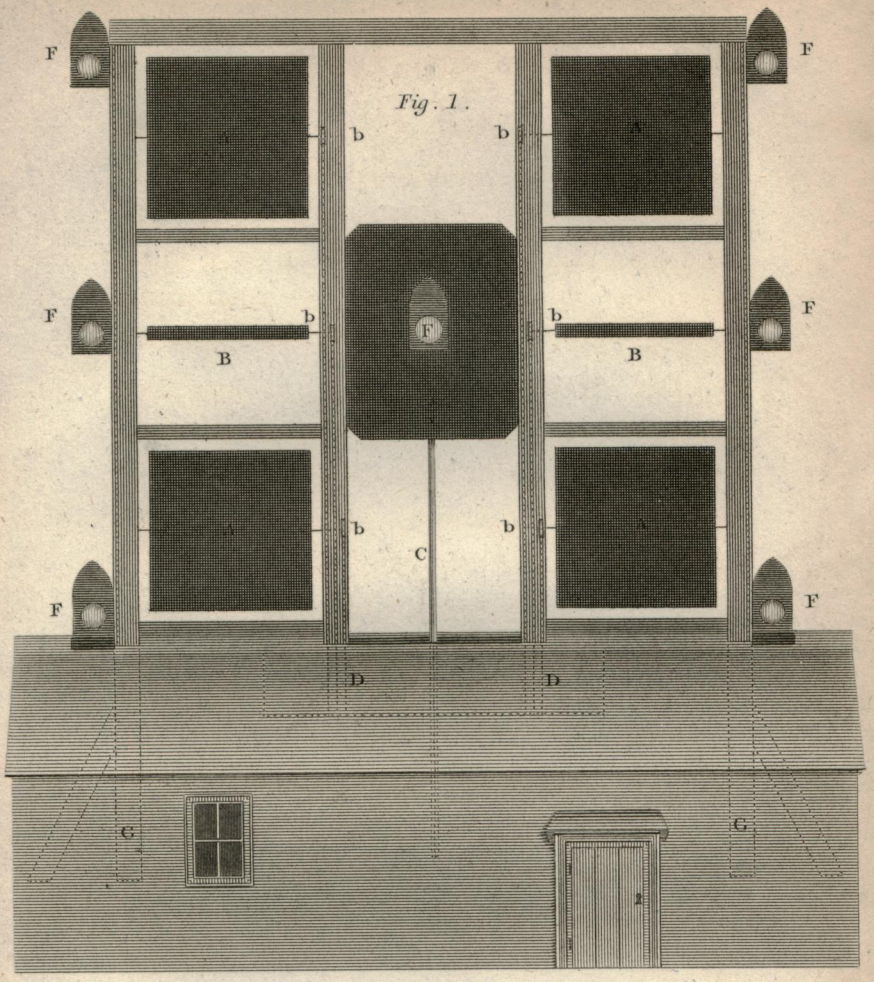
No. 14, *Crescent, Kingsland Road,*
13th March, 1805.

To CHARLES TAYLOR, Esq.

Reference

Mr. I. Davis's Day and Night Telegraph.

Fig. 1.



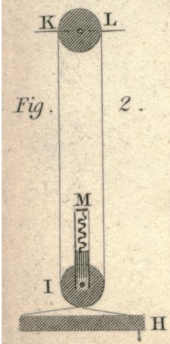


Fig. 2.

Fig. 4.

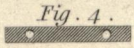
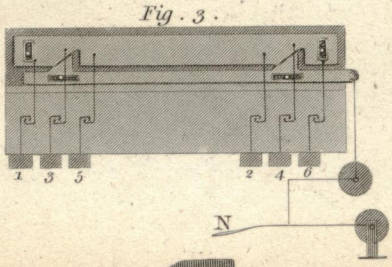


Fig. 3.



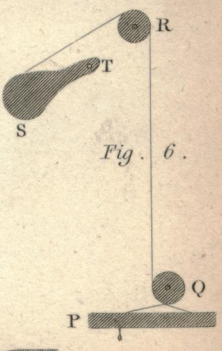


Fig. 6.

Reference to Mr. J. Davis's Telegraph, Plate IX.

Fig. 1. A view of the telegraph, with both the day and night parts attached thereto.

The centre shutter is represented in its vertical situation.

A A A A, Represent the four corner shutters in a similar position.

B B. The other two shutters lying horizontally.

C. A pole or rod, about one inch and a quarter diameter, to raise or lower the centre shutter.

Three cords on each side of the centre shutter work in grooves within the uprights, over small wheels or pullies *b b b b b b*, fixed upon the axis of each shutter.

F. The coloured lamp, fixed in the middle of the centre shutter.

F F F F F F. The six other lamps, three on each side.

G G. The inside frame-work of the uprights shown by dotted lines, and

supposed to be firmly fixed in the ground and supported by braces.

Fig. 2. H, Shows one of the wooden sliders, by which the shutter is moved; a cord fixed to the point H passes under the pulley I, and over the pulley K, fixed on the axis of each shutter; at the part L it is wedged into the pulley, so that it cannot pass without moving the shutter; M is a spring to give a proper tension to the cord, if affected by the weather.

Fig. 3, Represents the slides 1, 2, 3, 4, 5, 6, which work the shutters, with bolts to fix and unfix them. By means of the pedal N, the whole of the shutters may be bolted or unbolted at pleasure.

Fig. 4, Is a brass plate to receive the bolts last mentioned.

Fig. 5, Represents three of the side lamps, taken off and laid down; they are fixed to a slider, which runs

runs in a dove-tailed groove on the side of the outside supporter.

Fig. 6, Shows the method by which the blinds which cover the lamps are raised or let fall; P, the slider; Q, the lower pulley; R, the upper pulley, over which the cord goes; S, one of the blinds moveable on its centre T; another similar blind is upon the same axis, and rises or falls by the same cord, so that the light of the lamp is shown or excluded at both sides of the telegraph at the same time.

The night telegraph when out of use may be got ready in a few minutes, the lamps or lanterns being screwed to a piece of wood five inches wide, and one inch and a half thick, as shown in *Fig.* 5; which is fixed by sliding up a dove-tailed groove, tapering from top to bottom, which renders them easy to be raised, and perfectly secured by a bolt sliding underneath within the

building. Before the centre lamp F, which is the point or line of direction, is a plano convex, or double convex lens of any focus or diameter, formed hollow so as to admit of being filled with any transparent coloured liquor, to which lens there should be a neck or tube, to admit of the contraction or expansion of the coloured liquor.

The night telegragh has sixty-three changes, without varying the line of direction. The middle shutter of the day telegraph works in grooves on each side; it is raised or lowered by the pole C; if placed in the centre, it forms with the six shutters one hundred and twenty-six changes, and by being raised occasionally on a line with the upper shutters, or drawn down to the line of the lower shutters, will form in the whole two hundred and fifty-two changes. When not in actual work, it is lowered within the house.

FIFTY GUINEAS were this Session voted to Mr. ANDREW FLINT, for his Invention of an expanding BAND WHEEL, to regulate the Velocity of Machinery.

The following COMMUNICATION was received from him; an ENGRAVING of the Machine is hereunto annexed, and a MODEL thereof is preserved in the Society's repository, for the inspection of the public.

SIR,

I HEREWITH send you the models and description of two expanding band-wheels or riggers, for regulating the velocity of machinery, which I hope will meet the approbation of the Society.

I am, Sir,

Your most obedient servant,

ANDREW FLINT.

London, 22d May, 1805.

To CHARLES TAYLOR, Esq.

Description of the Model, Pl. X.

In the usual method of connecting machinery, by a band running over two wheels or riggers; it is obvious that the relative velocity of the wheels is in the inverse ratio of their diameters; and these diameters always remaining the same, no alteration of the velocity can be obtained, but by a corresponding variation in that of the moving power applied.

To enable the artizan to regulate the velocity of his machinery at pleasure, the moving power remaining as before, or to retain the same motion, with an alteration in that of the applied force, is the purpose of the invention, the models of which are now laid before the Society. In this model are shown two methods of attaining this desirable object; in both, the periphery of the band-wheel is divided into any convenient number of parts, according to the

Pl. X.

Fig. 4.

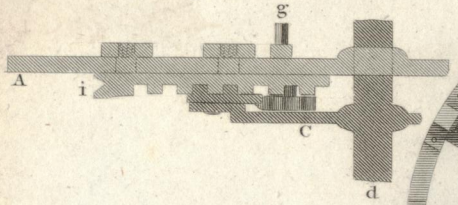


Fig. 3.

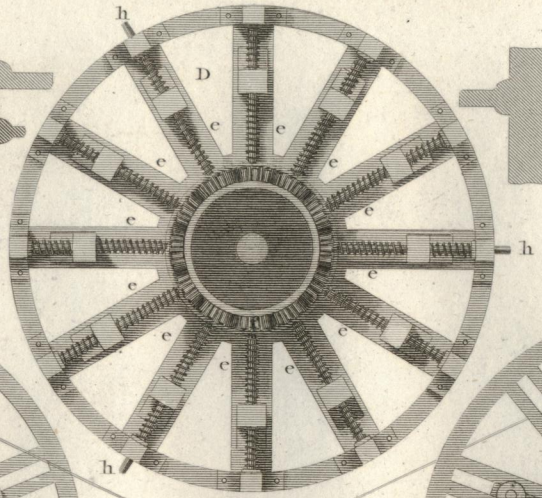


Fig. 5.

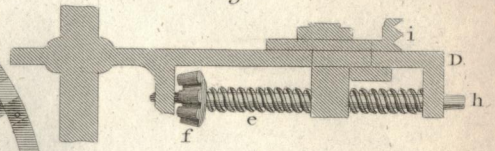


Fig. 1.

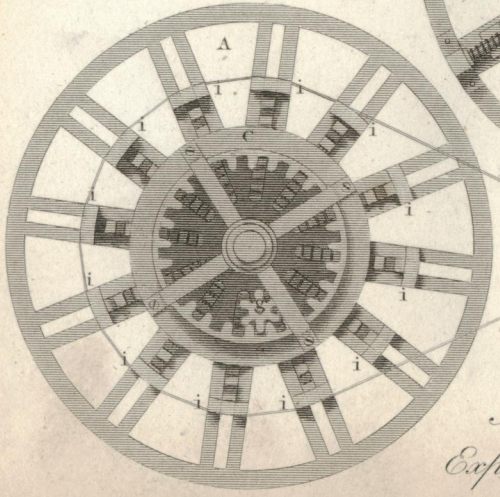
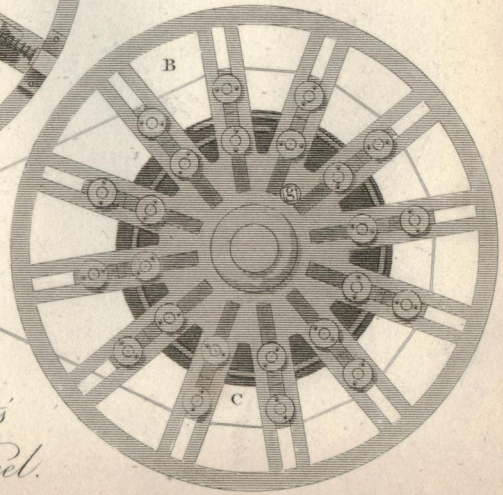


Fig. 2.



Mr. Andrew Flint's Expanding Band Wheel.

C. Varley del.

S. Porter sc.

the size of the wheels, (in this case twelve) which may be placed at any given distance from the centre of the wheel, (within the limits of the machinery) and thus, by enlarging the circumference of one band-wheel, while the other is equally diminished, to alter the relative velocity of each at will. These parts of the periphery, which I term V's, and are marked by the letters *i i i i i*, &c. are confined to move in grooves, cut in the large wheels A and B, *Fig.* I. and II. in the direction of their radii, and are moved by a spiral thread in the small wheel C, which thread takes in the teeth of the racks on which the V's are fixed. A part of the shaft on which the wheel A is fixed, is made circular, to admit the small wheel C to turn round independently of the other, and thus to extend or contract the racks and V's in *Fig.* III.—*Fig.* IV. is a section of part of the rigger, in which the letters refer to the same parts as in *Fig.* I. and II.

In the wheel D, the same effect is produced by the screws *e*, *e*, &c. which are made alternately right and left handed, and turn with equal motions, by means of the equal bevil-wheels *f*, *f*, &c. fixed at their ends near the axis of the wheel. *Fig.* V. is a section of the same.

The wheel C, *Fig.* I. and II. is moved round the shaft *d* by the pinion *g*, on the axis of which is fitted occasionally a winch. The screws of the wheel D, *Fig.* III. may be also turned, by means of a winch applied to their projecting heads *h*, *h*, *h*. It is proper to notice that the number of the screws must always be equal.

ANDREW FLINT.

Goswell-street, London.

The

The SILVER MEDAL of the Society and TEN GUINEAS were this Session voted to Mr. ROBERT SALMON, of Woburn, for an Improvement in CANAL LOCKS, and for preventing a waste of water.

The following COMMUNICATION was received from him; an ENGRAVING is hereunto annexed, and a MODEL is preserved in the Society's Repository.

SIR,

FOR the inspection of the Society of Arts, &c. I have forwarded my model, and you herewith receive enclosed a description thereof. The novelty of this mode of bringing into action a considerable force, will I hope appear; and I beg leave to observe, that besides the principle being applicable to locks, it will apply to many other

other uses, where a lift or descent is required. It may also be right to observe, that the curve may be so constructed, as to counteract the inclination of the load on the plane, under any irregular operation; and being so constructed, the load will in all cases be nearly as easily moved as if always running on a level surface.

I am, Sir,

Your most obedient humble servant,

ROBERT SALMON.

Woburn, April 23d, 1805.

CHARLES TAYLOR, Esq.

Description of Mr. R. Salmon's Model, for elevating and depressing Water, applicable to the use of Canal Locks, and for preventing the usual waste of water therein, with directions for working the same.—Plate XI. *Fig.* 1, 2, 3.

In *Plate* XI. C is supposed to represent a canal lock of the common construction,

construction, whose lower gates *i*, *i*, open towards or into the lock, and its upper gates *k*, *k*, open towards the upper or higher level of the canal; D is a hollow caisson, or water-tight chest, which is fitted to a walled chamber or side-lock, so as to move freely up and down therein; *i* is an opening, which forms a connection between the lock and the caisson-chamber, and which can be closed by a shuttle fitted thereto, when required. Four standards, *e*, *e*, *e*, *e*, are firmly fixed on the ground and walls of the lock and chamber; and four posts, *c*, *c*, *c*, *c*, are fixed in the four corners of the caisson; on each alternate pair of these standards and posts the frames *a* and *b* rest, as on so many fulcrums, or moveable joints; the frame *b* (*Fig.* 1 and 2) has two straight parallel bars of thin iron fixed thereto, and standing up above the same; the frame *a* has two similar bars affixed to it, except that the top edges of these are hollowed

lowed into a curve, as shown in the figures. B A, is a carriage loaded with two heavy leaden weights, and resting on four low brass wheels, having grooves in their circumferences like sash pullies, to receive the iron bars upon the frames *b* and *a*, so that the carriage can be drawn along upon them; the distance of the axles of their wheels is such, that when the wheels at B rest on the frame over two of the posts *c*, *c*, the wheels at A shall at the same time rest over the other two posts *c*, *c*, as shown in *Fig.* 1; and when the wheels at B rest over two of the standards *e*, *e*, the wheels at A shall at the same time rest over the other two standards *e*, *e*, in *Fig.* 2. In order to work the model, the carriage must be brought into the position shown in *Fig.* 1, and this can readily be done by stops, which are provided in the proper places on the curved bars, for preventing the wheels from rolling too far; as much water must

must then be poured into the lock C, as will fill it exactly to the black line *d*, *d*, withinside the same; and if the table on which the model stands, be not level, small wedges or chips must be put under the model where necessary, until the surface of the water exactly corresponds, all round the lock, with the top water-mark or line above-mentioned; it must likewise be observed, to place the model across the table, so that the weight *h*, when hung over the pulley *f* or *g*, may be at liberty to descend. Then hang the two-pound weight *h*, *Fig.* 1, by the line over the pulley *f*, at the upper end of the lock; and the carriage, or load B, A, will be drawn forwards into the position shown at *Fig.* 2, and the water in the lock C will pass through the shuttle, to buoy up the caisson D, and its surface in the lock will descend to the lower level. Again, by shifting the weight to the lower end *g*, the load will again be brought

brought back, the caisson depressed, and the water forced through the shuttle, again raised to the higher level *d*, *d*, in the lock, as in *Fig.* 1.

Hence it is evident that the water in the lock, with or without a boat therein, may be raised or lowered, by the application of any force to move the carriage or load, horizontally on wheels. That when it is intended to pass a boat from the upper to the lower canal, the water in the lock is raised to the top water-level *d*, *d*; the upper gates *k*, *k*, are then readily opened, and the boat floated into the lock; this done, and these gates shut, the water and boat, by withdrawing the load from the caisson, is lowered to the lower level of the canal. The lower gates *i*, *i*, are then opened, and the boat floated from the lock to the lower canal. In this operation of lowering a boat, it is evident, that so far from there being a waste of water, a weight of water equal to the boat

boat and its load is raised from the lower to the upper canal; for when the boat at the upper level first enters the lock, its own weight of water is displaced, and forced into the upper canal. And again, when it is floated into the lower canal, as much is again from that canal displaced, and forced into the lock.

On the same principle that water is gained by a descending boat, as above described, it will be observed, that no waste ensues in an alternate passage; and that in an ascending passage, a loss of water equal to the boat and its load only takes place.

It should be understood, that as canals are sometimes more or less full of water, locks on this principle must be constructed to raise and depress, to the greatest extremes that ever happen, from the highest high-water, to the lowest low-water mark, and that being so constructed, they will apply to any intermediate

termediate heights; the curved plane *a* being formed, to adjust and counterbalance the inclination of the wheels on the other plane *b*, thereby maintaining an equilibrium, at any intermediate height, which the water in the canal may happen to be at.

Having described its manner of operating, I shall explain and compare cause and effect; for which purpose it may be requisite, first to state, that the load of the carriage B, A, is fifty-six pounds, which weight, when advanced, presses directly over the parts *c*, *c*, *c*, *c*, with all its gravity bearing on the caisson; but when the load is drawn forwards, it rests entirely on the fixed standards *e*, *e*, *e*, *e*, and by this change the whole effect is produced.

Now, if the model be set properly to work, it will be found, that a two-pound weight suspended over the pulley at either end, will put the carriage in motion, and thereby raise or depress the water in the lock, and that to do so, the

Mr. Salmon's Improvement on Canal Locks.

Fig. 1.

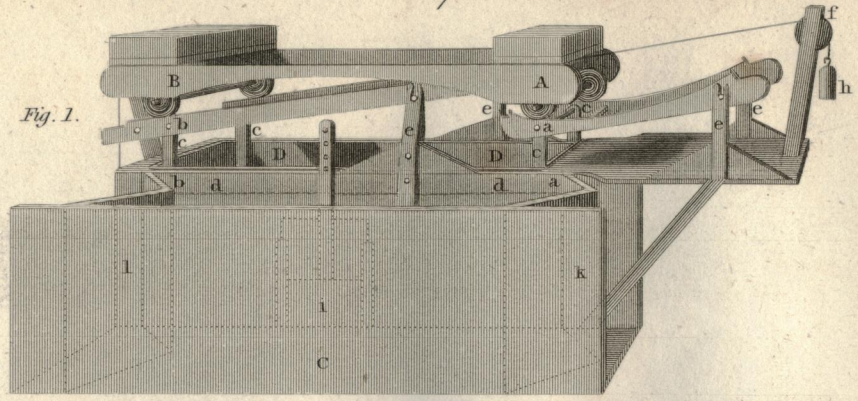


Fig. 2.

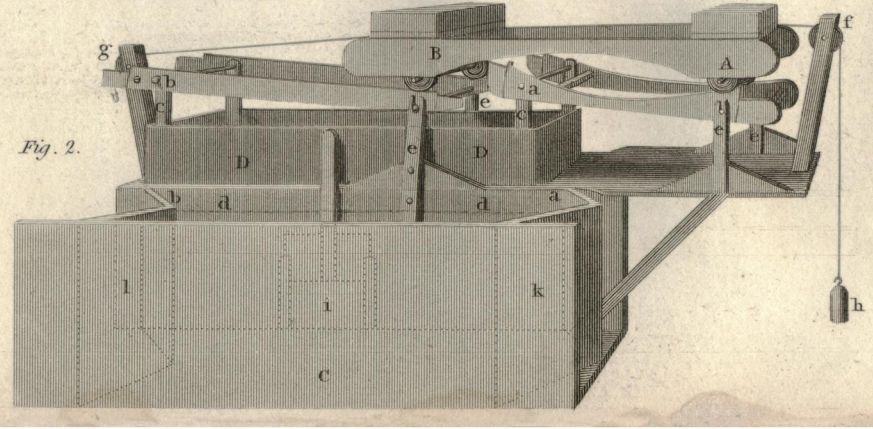
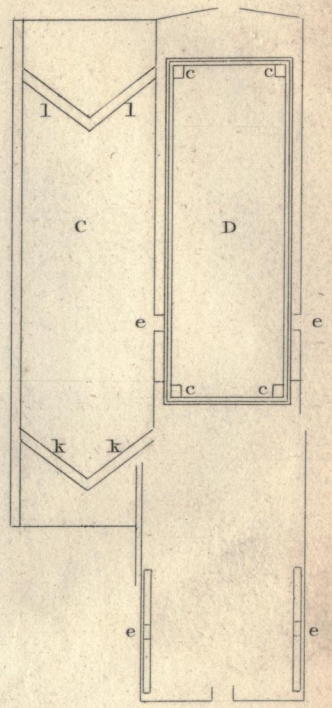


Fig. 3.



C. Varley Sculp.

S. Porter sculp.

the two-pound weight will descend sixteen inches. Hence, two pounds descending sixteen inches, may be denoted the cause or power to produce the effect. Farther, it follows, that this two-pound weight descending sixteen inches produces the same operation as fifty-six pounds laid in the caisson would perform, and this sinking of the caisson D may be denoted the direct effect produced by the two-pound weight. The indirect and requisite effect being that of depressing or elevating the water in the lock C, and the comparison thereon will stand thus: the surface of a body of water, of an area of twenty-four inches by ten, is raised about four inches and a half by the power of two pounds descending sixteen inches; and, *vice versa*, by reversing the power, the water is again depressed.

The shuttle *i*, between the lock and the caisson chamber, will regulate the

time of the ascent or descent of the caisson.

R. SALMON.

Woburn, 23d April, 1805.

CHARLES TAYLOR, Esq.

SIR,

IN reading over the copy of the paper which I hastily drew up, and sent with my model, I observe that I omitted making any remarks on its applicability, improvements to be made in the carriage to facilitate the moving of the load, and on the different other ways, besides the one shown in the model, by which it may be put in action.

It will readily occur to every engineer, that this sort of lock is not confined to the particular shape of the model, or to any particular form. The caisson chamber may be placed endwise to the lock; may be of any shape,

and

and placed at a nearer or further distance, as may be required.

On comparing the length and movements of the frames in the model, with what may be required in practice, it will appear that the length of timbers at large will not be such but that strength sufficient may be obtained for any load. It is also evident, that, although the frames consist of only two bearers in the model, yet, at large, any number may be introduced, parallel with each other, and as many wheels as bearers.

In this operation the weight of the carriage itself contributes towards the effect, which in common cases is otherwise, as generally there is an objection to the great weight required to make a carriage sufficiently strong for any extraordinary purpose; and there is no doubt but, by an improvement of the carriage, it may be made to require much less than the power used in the present

model. The mode I should pursue would be, to make the load in the wheels themselves, that is to say, the necessary load to produce the effect should be two solid iron cylinders, running on as many bearers as are requisite, and to have a frame or carriage for the purpose only of connecting the cylinders; by these means, the strength and friction of the axletrees would be reduced very much, and the means required then to perform the operation would be only to put the body in motion, and to overcome any little obstacle or irregularity, that the peripheries of the cylinders would meet with in their progress.

The advantage of rollers over wheels has been admitted, even where the peripheries of the cylinders were in contact with the incumbent weight resting on the top of them, as well as with the supporting plane below; but, in the case above suggested, they have more advantage,

vantage, being only in contact with the upholding frames.

With respect to its operation, if any objections should be found to the great animal power that would at large be required, it will occur, that various other means may be used to put the carriage or load in motion; some without any loss of water, and others with a trifling loss, compared with what the lock holds. Thus, when the caisson is up, if, by a cock, a portion of water be let into it, the equilibrium will be destroyed, the caisson will sink, and the water in the lock be raised. Again, if by a pump, or other means, the water be returned from the caisson to the lock, the caisson will rise, and the load of itself recede, and this would be without waste of water. To put it in motion with a certain portion of waste, it is presumed, different ways may be found, as the introduction of a portion of water from the upper canal to the lock,

or the discharging of it from the lock to the lower level, these would with management occasion the caisson to rise or fall; or, if a part of the load were made to shift farther from, or nearer to the fixed standards *e e e e*, it would thereby cause the action required, and perform the operation; and it is probable, that a better way than any here suggested would arise, should the thing be put in practice.

I am, Sir,

Your obedient humble servant,

ROBERT SALMON.

Woburn, May 4th, 1805.

CHARLES TAYLOR, Esq.

The

The SILVER MEDAL of the Society was this Session voted to Mr. J. J. HAWKINS, of Dalby Terrace, City Road, for his Invention of a MACHINE for CUTTING PAPER and the EDGES of BOOKS.

The following COMMUNICATION was received from him; an explanatory ENGRAVING is hereunto annexed, and a MODEL is preserved in the Society's Repository.

SIR,

THE Society for the Encouragement of Arts, &c. having done me the honour to elect me a member of their body, I feel myself bound to be active in endeavouring to promote the objects of the Institution; and beg leave to present, by way of earnest, a model of a press, in which books or paper may be cut on the three edges at one fixing.

This plan occurred to me about four years ago, when I had two or three presses made, which were used by some book-binders in Philadelphia, and found to save much time, besides ensuring the books to be of one size.

The model is not made to any scale, because the size must vary with that of the books to be cut.

I am, Sir,

Your humble servant,

JOHN J. HAWKINS.

London, April 24th, 1805.

To CHARLES TAYLOR, Esq.

SIR,

THE object of this improvement is, to cut the edges of books on three sides at one fixing in the press: to do this, it is necessary that the book be placed at one end, and a support given to the plough beyond the part cut; there is therefore at each corner, a block moveable

moveable on a centre, so as to elongate alternately the side or end of the press.

The press is as wide as the intended length of the book.

At a distance from the end of the press, equal to the required width of the book, is a stop, made somewhat like two combs, one fastened on each side, the teeth of one going into the interstices of the other, so that it may effectually prevent the book falling too low, whether the press is open little or much.

In the common press, the book is put in the middle, and there is a screw at each end to force the press together; but in this press, the book being put at one end, there is a screw about the middle to force the press together, and another screw at the lower end to force it open, and consequently press the book tighter, exactly on the principles of cabinet-makers hand-screws.

Reference

Reference to the Engraving, Plate XII, *Fig.* 1, 2, 3, 4.

Fig. 1 and 2. Two geometrical views of the press.

Fig. 3 and 4. Two perspective views of the same, as placed on its supports in the box which receives the cuttings. The side of the box is represented as taken away, in order to show the parts more distinctly. *Fig.* 3 shows the position of the press, when the front of the book is to be cut, and *Fig.* 4, while the ends are cutting.

N.B. The letters of reference are the same in all the *Figures.*

A. The press.

a. The cutting box.

b b. The elongating blocks turning on their centres *(c)*

d. The screw which forces the press together.

e. The screw which forces the lower ends of the press asunder, and consequently presses the book tighter.

f. A

f. A piece of board put into the press with the book, to keep it firm against the knife.

g. The comb-like stop.

h h. Bars fixed across the cutting box, to support the press while the top or bottom of the book is cut.

i i. Bars to support the press while the front of the book is cut. In this position, there is a bar *(k)* to keep the press steady, which is taken out when the position *Fig*. 4 is in use.

l l. Pieces of board with notches in them, fastened to the box, to receive the bars.

m. Groove for the plough to work in.

It is evident from the positions of the press, that the plough must be worked on an inclined plane; but this, instead of an objection, is a considerable advantage, because the workman has much more power in that direction, than on a level.

The press requiring to be turned round to cut the top and bottom of the book,

book, the plough must be worked left as well as right handed, but this is acquired by a few minutes practice.

The same plough is used as with the common press.

J. J. HAWKINS.

Dalby Terrace, City Road,
May 29th, 1805.

CHARLES TAYLOR, Esq.

FIFTEEN

Pl. XII.

Mr. H. Ward's new striking Movement in a Clock.

Fig. 5.

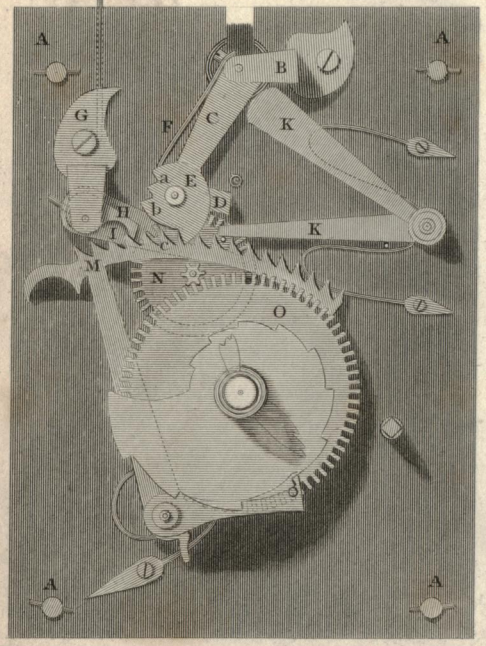


Fig. 2.

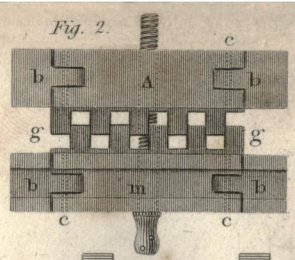
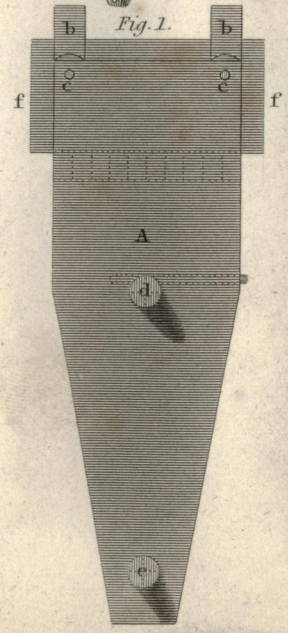


Fig. 1.



Mr. Hawkins' Machine for cutting the Edges of Books.

Fig. 3.

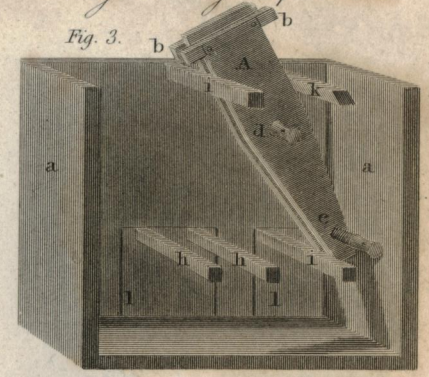
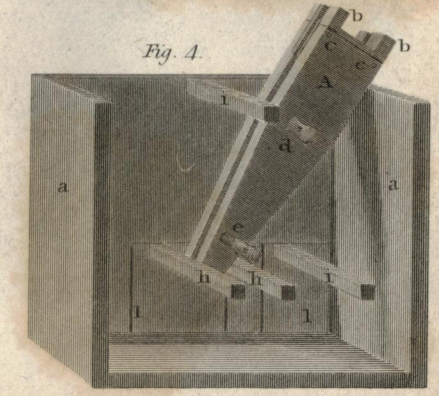


Fig. 4.



C. Varley del.

S. Porter sculp.

FIFTEEN GUINEAS were this Session voted to Mr. HENRY WARD, of Blandford, in Dorsetshire, for a new STRIKING CLOCK MOVEMENT.

The following COMMUNICATION was received from him; an explanatory ENGRAVING is hereunto annexed, and a CLOCK upon this principle is preserved in the Society's House.

SIR,

THE clock sent herewith is the invention of Mr. Henry Ward, of Blandford, in Dorsetshire. He has requested me to lay it before the Society for the Encouragement of Arts, Manufactures, and Commerce.

He hopes they will be pleased to examine the clock he has sent, and that they will think his invention worthy of some mark of their approbation,

I am, Sir,

Your most obedient sevant,

CHARLES SMITH.

Bunhill-Row, Feb. 14th, 1805.

CHARLES TAYLOR, Esq.

Reference to the Engraving, Pl. XII. *Fig.* 5.

Description of an Eight-day Clock, with an improved Striking Part, by Mr. Henry Ward, of Blandford, Dorsetshire.

The striking part of this clock is so far simplified, that the whole train of wheels used in common clocks, together with the barrel and weight, are entirely superseded.

The power necessary for raising the hammer is obtained from the pendulum.

A A A A, represent the front side of the frame. B, a cock in which rests the pivot of the pallet arbor. C, a brass arm firmly fixed on the same. D, the gathering pallet, and E, a thin plate of brass, both rivetted on the same collet, which turns on a small stud fixed in the arm C; this brass plate has two notches in

in it, at *a b*, in which acts a slender spring F, fastened to the collet of the arm C, by a small screw, and serves to keep the gathering pallet in its proper position. G, the cock of the hammer-bar. H, the hammer-tail, which acts also as a hook in the teeth of the rack. I, a brass arm, or rather a lever, which lies behind the minute-wheel N, and is fixed with the hammer-tail to the hammer-bar by means of a pin. K, the flirt. M, the rack. N, the minute wheel. O, the hour wheel. The bridge and snail are the same as in a common clock.

The operation of this work is as follows. A pin is fixed in the back of the minute wheel N, and as it revolves, raises the lever I, by which the hammer-tail H is lifted out of the rack, the rack is then at liberty to fall; the lever I, by bearing against the pin, returns gradually, and prevents the hammer from striking the bell.

Before

Before the pin has quitted the lever I, another pin in the front side of the same wheel begins to lift the flirt; when raised to a sufficient height, it is let go by the pin, and falls on the gathering pallet D, which forces it into the rack; it is prevented from rising out of the rack by the spring F, having got into the notch *b* of the brass plate E; the pallet immediately acts on the rack; for, as the arm C moves from left to right, it lays hold of a tooth, and carries it along with it by means of the *vis inertiæ* of the pendulum, at the same time the hammer-tail is raised by another tooth of the rack, and on quitting it the hammer strikes the bell; when the arm C returns with the gathering pallet from right to left, the rack is prevented from returning with it by the tooth resting against the end of the hammer-tail, the pallet is then carried over another tooth, and at the next vibration moves the rack and hammer-tail as before; thus they continue

continue to act alternately on each other till the rack is up, and the clock makes one stroke regularly at every other vibration.

Now, in order to disengage the gathering pallet, there is a pin fixed in the rack at *c*, and as soon as the last tooth of the rack has got past the hammer-tail, the shoulder of the brass plate E, which is rivetted to the pallet, strikes against the pin *c*, and lifts it out of the rack, the spring F jumps into the notch *a*, and prevents it from returning; thus it remains detached, and the pendulum continues to vibrate without any obstruction. The ball of the pendulum weighs about eight pounds thirteen ounces; and the weight twenty-four pounds. The clock has a dead scapement.

The objection that may perhaps be made to this clock is, that the striking part disturbs the isochronism of the pendulum; but whoever will take the trouble to try it against another pendulum, of the same length, both before

and after it has struck, will find no sensible alteration; and even if that were the case, the irregularities would be periodical, and return to themselves every twelve hours.

The advantages which I conceive this clock to have over a common clock, are as follows.

First.—That it is not attended with that disagreeable roaring which is frequently heard in the wheels and pinions of others, and particularly the fly pivots when in want of oil.

Second.—That the interval between the strokes is uniformly the same: the case is very different in other clocks, for as they get foul they always strike slower, and more so still when the weather is cold.

Third.—That in consequence of its simplicity, it is not liable to be out of repair.

Fourth.—That it can be manufactured for considerably less expense.

Henry Ward.

TWENTY GUINEAS were this Session given to Mr. JOHN ANTIS, of Fulneck, near Leeds, for a DETACHED ESCAPEMENT of a PENDULUM CLOCK; from whom the following ACCOUNTS were received.

A MODEL thereof, attached to a REMONTOIRE, invented and presented by Mr. ANTIS, is placed in the Society's Repository, for the inspection of the public.

SIR,

I HEREWITH send you the detached escapement for clocks, which I formerly mentioned to you. Since I wrote to you, I have made some trifling alterations in the small piece which locks and unlocks the wheel. You will find that this is done with so little resistance, that the mere weight of the anchor is more than sufficient

ficient to keep it going if once set in motion. I have inserted it in a small clock of mine, and it is surprising what a difference it made in the pendulum; the same force of the spring will carry one three times as heavy as before, and still the motion will be larger and freer. If I followed the trade of a clock-maker, I would insert a small flat ruby, instead of steel, into the place where the friction of locking and unlocking the wheel is, as likewise into the anchor.

I remain, Sir,

Your obedient servant,

JOHN ANTIS.

Fulneck, Dec. 5th, 1803.

CHARLES TAYLOR, Esq.

SIR,

SIR,

I LATELY mentioned to you, that I hoped soon to send you an invention to equalise the power of the impulse, to a balance or pendulum in chronometers or clocks. I now inform you that I have this day sent it; it is accompanied with a letter, directed to you, containing a full description of the machine. If the same thing has not been done before, it may be of considerable advantage to chronometers used at sea, to determine the longitude; advantages of this kind, if to be found, must be of very great moment. I have found by experience, that an improvement was necessary in the contrivance of my late machine, to lock and unlock the swing-wheel in a clock, which I introduced into my last model; for as the little piece of brass with the slanting piece of steel, which serves to unlock the wheel,

moved near its centre against two broad surfaces, and only fell by its own weight, it performed very well when quite clean; but after a little time an imperceptible roughness formed itself, which prevented it from falling by its own weight in its proper situation, and so it stopped the clock. I did not like to add a small spring to force it, for that, little as it might be, would take power from the impulse; I therefore altered it as you will now see in the model.

In this way it is still lighter than the old one, and turning upon very small pivots it will be free from all former obstructions. It succeeded and stood its trial so very well, that I wished to send a new pattern of it to the Society, and this was the reason why I made use of the same escapement; otherwise, I would rather have made a balance, as my invention was chiefly meant for chronometers, though it will be full as useful for

for astronomical clocks as any others, where accuracy is required. Because, by these means, a spring clock will be as perfect as one which goes by weight, and more so if the latter has no remontoire; because, though free from the friction of the spring, it would not be free from the inaccuracies of the train of the wheels without it.

Being deprived of the opportunity of conversing with scientific persons upon the subject, I might easily be led to think that, which my imagination suggests, to be new, though it may have been practised before. Yet as there still is a possibility that a person in my situation may hit upon something which may have escaped the sagacity of others, I resolved to send the model of it. I have other disadvantages in the place where I reside, viz. I have no person to assist me, but am obliged to execute my thoughts by my own hands only, whether the work be in wood,

steel, or brass, nor can I always find the necessary materials and tools ready. It will be no wonder therefore if skilful workmen may in some cases have reason to find fault with the execution.

I remain, with great regard, Sir,

Your most obedient servant,

JOHN ANTIS.

Fulneck, Nov. 17th, 1804.

CHARLES TAYLOR, Esq.

The

The SILVER MEDAL of the Society was this Session voted to Mr. JOHN ANTIS, of Fulneck, near Leeds, for his improved DOOR LATCHES.

The following COMMUNICATION was received from him; an explanatory ENGRAVING is hereunto annexed, and MODELS of the LATCHES are preserved in the Society's Repository, along with DRAWINGS thereof.

SIR,

I DO not doubt but that you are persuaded of the necessity of having a door-latch superior to, and not so liable to be out of order as those hitherto in use, in the door-locks of dining-rooms, &c. Some time ago, I made an attempt to contrive such a one, which I fixed into a small box by itself; I have now tried it for some years in my own

own house, during which time I never found occasion to clean or to oil it. I at that time thought there would be a difficulty to introduce it into a mortise lock, in such a manner as to place the nobs and the key-hole symmetrically. That difficulty I have now overcome, and take the liberty to send you a pattern, for your inspection.

My object has been to contrive a simple latch, as much as possible without friction, not more expensive than those hitherto in use, and capable of moving smoothly and easily without the necessity of cleaning and oiling, as long as the metal will last of which it is made. How far I have succeeded, I leave to the decision of the Society.

I am, Sir,

Your humble servant,

JOHN ANTIS.

Fulneck, April 3d, 1804.

To CHARLES TAYLOR, Esq.

Reference

Reference to Mr. Antis's Improved Door Latch, Plate XIII. *Fig.* 1.

A, Shows the hole for the handle, which moves the follower and latch.

B. The follower which draws back the latch, on turning the handle either way.

C. The latch.

D. The longitudinal spring, which throws out the catch of the latch when the hand is withdrawn.

E. The small bolt, to secure the door internally.

F. The key-hole, the bolt of the lock of which is not shown, being placed above the key-hole.

THIRTY GUINEAS were this Session voted to Mr. J. WATKINS, No. 9, Giltspur-street, West Smithfield, for an Improvement in TIME-KEEPERS; from whom the following COMMUNICATIONS were received.

An ENGRAVING is hereunto annexed, and a MODEL of this Invention is preserved in the Repository of the Society.

SIR,

I HAVE taken the liberty of sending you, for the Society's inspection, a model of an improvement for constructing time-keepers, or for ascertaining the longitude at sea.

The principle of the improvement is to reduce friction, it being the greatest enemy to machinery in general, but more especially to such as is intended for measuring time; for, while my plan retains every advantage of the best similar improvements hitherto made, the friction of the most essential parts is reduced full

one

one half, consequently better performance may be expected, and the machines be more durable.

I have sent a sketch of the dip or depth that rollers of the same size take into a wheel, by placing them in different positions and describing the same angles.

I have by me, and belonging to the model I have sent, other wheels of the most eminent makers; such as Arnold's famous epicycloid wheel, and Mr. Earnshaw's; and by applying them to the machine, my plan is clearly proved to be preferable to any other.

If any explanation is needful, I shall be proud of giving it, to the best of my abilities; and remain, Sir,

Your most obedient
and very humble servant,

J. WATKINS.

No. 9, Giltspur-street, West Smithfield,
October 9th, 1804.

To Mr. CHARLES TAYLOR,
Secretary to the SOCIETY of ARTS, &c.

SIR,

SIR,

NOT having sent you an explanatory or descriptive account of the properties of my model, for an improved detached escapement to reduce the friction in time-keepers for ascertaining the longitude at sea, I now take the liberty, for the information of the Society, to send you my opinion of the advantages which I think it possesses over any that have hitherto been made.

The good performance of time-keepers entirely depends on three things, viz. the escapement, balance, and pendulum-spring; and I am convinced, from the experience I have had in time-keepers, that a considerable share of the trouble attending the adjustment of them in different positions, arises from the general mistaken judgment in giving the impulse to the balance, also from not thoroughly understanding the properties of the pendulum-spring. I am, Sir,

Your humble servant,

March 6th, 1805. J. WATKINS.

CHARLES TAYLOR, Esq.

Observations

Observations on an improved detached Escapement for Time-keepers for ascertaining the longitude at sea, on a principle to reduce friction.

The good performance of time-keepers for ascertaining the longitude, entirely depends on the regular and uniform vibrations of the balance, which likewise depends on two particular parts of the machine, viz. that which is called the escapement, or the parts immediately connected with the balance to give it motion; and a proper compensation part to regulate itself in different climates; which two are the only parts now worth attention: for, although it must be acknowledged, that time-keepers have of late been brought to very great perfection, yet I think it must be admitted, that they are susceptible of still greater improvement; and, considering the amazing service they have rendered to navigation, every possible encouragement

couragement ought to be given to render them still more serviceable.

The escapement is composed of two distinct parts of action. First, that which the wheel locks, or rests upon, while the balance is in motion; and, secondly, that which gives the impulse to the balance after it is unlocked: and those that are made with the least friction are undoubtedly the best.

The contrivance of locking the wheel on a spring, if properly made, is I think as perfect as human invention can produce; but the mode of giving motion to the balance, I by no means think is so: for when you compare the manner in which the balance of a watch is kept in motion, with the pendulum of a clock, you must give the preference to the latter. The former, moving on opposite centres, as soon as they come in contact, oppose each other, till they come into a straight line, and in leaving each other occasion considerable friction up the

the side of the tooth, which action not according with the motion of the balance, greatly retards its progress.

The manner in which the pendulum of a clock is kept in motion is very different; for as soon as the wheel is unlocked, it receives the impulse from what is called a crutch, which being suspended on the same parallel of suspension, describes exactly the same circle, and consequently there cannot be the smallest friction whatever. After many and various trials which I have made to produce the same principle in watches as is in clocks, I found I could not give the impulse from its own centre without introducing other pieces which would counteract the good effect derived therefrom; nevertheless I was determined to approach as near to it as possible, and to employ no more parts to produce the effect, than are used in those of the common construction.

In order to do this, I made a horizontal contrate wheel, and cut teeth on the uppermost rim of it; I introduced a piece of brass inside it, just free of its bottom, on which I placed, half-way between the extremities and centre of the wheel, the axis of the balance, on which I put a round piece of steel with a notch in it, called the impulse pallet, and nearly half the size of the wheel's diameter. After the wheel is unlocked in the usual way, with a spring, the pallet receives a tooth on the point of the notch, which forces it round in a circular direction nearly corresponding with its own; consequently, there cannot be so much friction, as the teeth do not take above half the usual depth into the impulse-pallet, in which case jewelling will be quite unnecessary; the machines must last longer, and as good performance depends on the uniform motion of the balance, there is not the smallest doubt but, if justice is done

done in executing the other parts of this escapement, and a proper compensation for heat and cold, they will perform more accurately than any that have been hitherto invented; but in case any doubt should arise on my plan of placing the impulse-pallet in the midway, between the extremities of the wheel and its centre, I beg leave to offer this single proposition, the propriety of which will not admit of the smallest doubt, viz. If it be perfection to give motion to a body acting on pivots from its own centre; the nearer you approach to that centre, the less friction there will be.

J. WATKINS.

Reference to the Engraving of Mr. Watkins's Improvement in Time-keepers, Plate XIII. *Fig.* 2, 3, 4.

Fig. 2. A perspective view.

A. The circular frame of the machinery.

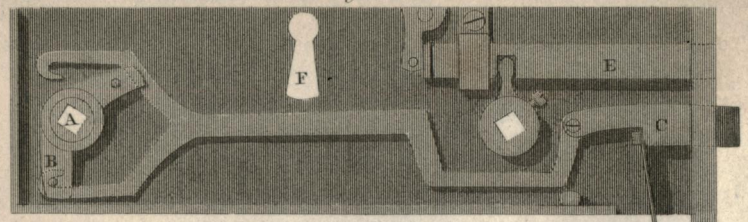
B. The pendulum-spring.
C. The balance.
D. The axis.
E. The cock in which the upper pivot of the axis runs.
F. The impelling pallet, on the axis of which is a small unlocking pallet.
G. The detent and unlocking spring.
H. The axis of the scape-wheel, supported by a cock below it.
I. The scape-wheel.
K. The cock which supports the lower axis of the balance and scape-wheel.
L. The screw for adjusting the locking of the wheel.

Fig. 3. A bird's-eye view.

A. Part of the circular frame of the machinery.
C. The balance.
M. The small unlocking pallet, above the impelling pallet F.
G. The detent and unlocking spring.
I. The scape-wheel.

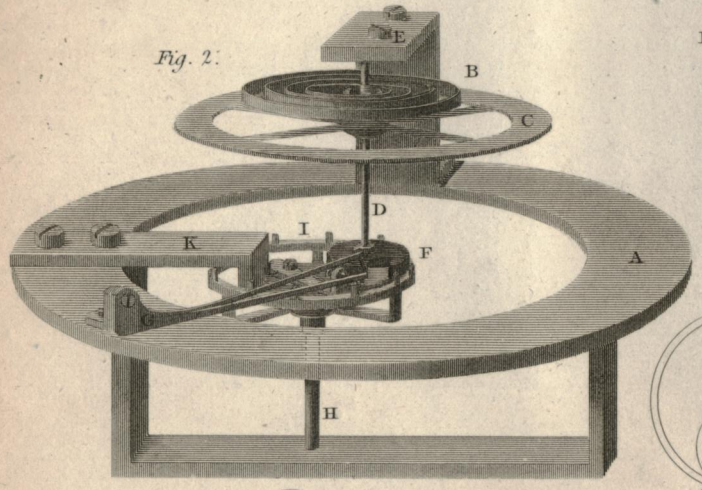
L. The

Fig. 1.



Mr. Antis's Door Latch.

Fig. 2.



Mr. Watkins's Improvement

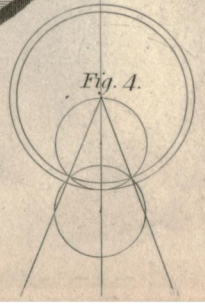


Fig. 4.

Mr. Wm. Hardy's Compensation [illegible]nce.

Fig. 6.

Fig. 5.

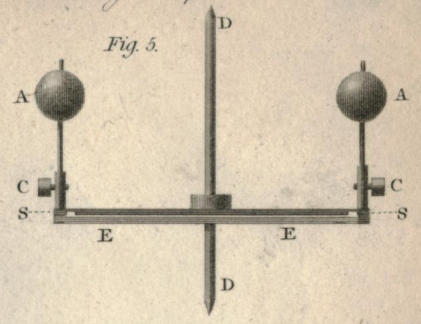
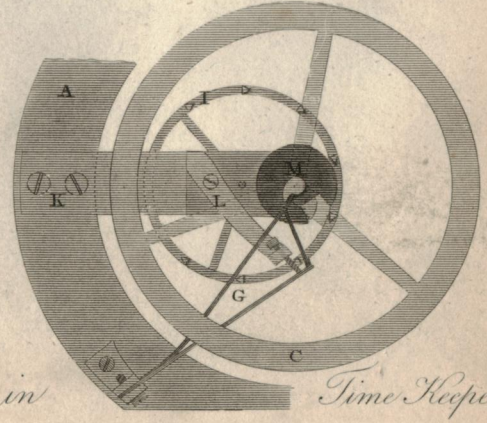


Fig. 3.



in Time Keepers.

C. Varley del.

S. Porter. sculp.

K. The cock which supports the axis of the balance and scape-wheel.

L. The screw and small cock for adjusting the locking of the wheel.

Fig. 4, Is a diagram to show Mr. Watkins's intention of reducing friction, by bringing the action more concentric with the scape-wheel.

THIRTY GUINEAS were this Session voted to Mr. WILLIAM HARDY, No. 3, New North-street, Red-Lion-square, for his invention of a COMPENSATION-BALANCE, for TIME-KEEPERS; from whom the following COMMUNICATION was received.

A DRAWING, to explain the nature of this invention, is hereunto annexed, and a MODEL is preserved in the Society's Repository.

SIR,

THE honour done mē, and the encouragement which I, last session, received from the Society of Arts, for my contrivance of a banking to a time-keeper, embolden me to trouble the Society with a new compensation-balance, which I conceive to be more perfect and permanent in performance, than

than any hitherto presented to the public; and I have every reason to expect that it will be found of equal, if not greater importance than my last contrivance.

I am, Sir,
Your obliged and humble servant,
WILLIAM HARDY.

CHARLES TAYLOR, Esq.

Description of a new permanent Compensation-Balance for a Time-keeper.

We have at present two compensation-balances: one sort consists of several slips of brass and steel soldered, or fluxed together, and disposed in form of two S S's on the balance, but this is now almost out of use. The other is a steel balance, having a rim of brass fluxed upon its outside, and cut open in two or three places, with sliding weights placed on the rim, to increase or di-

minish the effect of the balance. The nature of this balance (the only one now in use) is well known, as well as its defects, which it is unnecessary for me to state at this time, as I shall have a better opportunity of pointing them out at large, should I be ordered to attend the Society.

Instead of this uncertain way of constructing a balance, which never continues long in the same state, but requires to be adjusted every time the watch wants cleaning; I have rejected this mode altogether, and have contrived a method of applying the direct expansion of metals, which I find by experience to be constant and permanent in its effects.

My balance consists of a steel flat bar, which forms its diameter. Beneath this steel bar are two metallic rods, secured at one end by a stud, formed out of the steel bar, and the other end acting on the short end of a lever, formed

formed out of the other end of the same steel bar, being made to spring at the place where the centre of the lever would fall; to this lever is fastened a small cylindrical stem of brass, upon which a small globe of brass slides or screws; there is also a screw passing through the stem, to serve to regulate to mean time. Another metallic bar, equal and similar, and furnished like the other, but reversed in position, is placed parallel to it.

Mode of acting.

When the whole balance is heated, the metallic rods will push forward the short ends of the levers, and which quantity will be just equal to the difference of the expansion of the two metals. Suppose the short ends of the two levers to be each equal to 1, and the long ends of the levers to be each equal to 20, then it is evident that the

the motion of each globe will be twenty times the excess of the steel bar and metallic rods nearer to the centre of the axis of the balance, than before the expansion took place; and, what is a very grand and necessary property in the motion of the two globes, they will always move directly to the axis of the balance; that is, their action will be constantly in a plane, passing through the axis of the globes and axis of the balance. To increase or diminish the expansion of the balance, will be only to slide or screw up or down the globes upon their stems, until the balance produces the desired effect.

To CHARLES TAYLOR, Esq.
Secretary to the SOCIETY of ARTS, &c.
Feb. 13*th*, 1805.

SIR,

IN addition to what I stated in my last letter, concerning my balance, I beg further to state the following considerations.

The

The rim of brass and steel of the common balance, however intimately connected when first fluxed together, are by every change of temperature endeavouring to break the connexion, and do by little and little tear themselves asunder, at least in a partial degree, for the fracture is often visible, so that the balance has nothing permanent in its nature. New adjustment is necessary much oftener than the instrument requires cleaning: but that adjustment is of no duration; for, as the pores are more torn than at first, the balance becomes worse and worse, and at last quite useless for what it is intended.

I make use of the direct expansion of metals; for the bars of my balance are independent of each other. They are connected only at the extremities, and the excess or difference of the expansion of the two metals is communicated to the short ends of the two spring levers.

levers. Its durability can therefore no more be doubted than that of the grid-iron pendulum, where the direct expansion of metals produces the desired effect.

The two globular weights were described in my last letter as moving constantly in the same plane, which passes through their centres and the axis of the balance; and I should have added that, as to sense, they also move in the same right-line which passes through the centres of the globes, and cuts the axis of the balance at right angles; for the versed sine of a very small arch, or the difference between the radius and co-sine, is in this case a quantity so small that it cannot be perceived; and however we increase or diminish the expansion of the balance, or whatever may be the degree of temperature, it still retains this admirable property, namely, that the two spherical weights move not only in the same plane in a strict

strict mathematical sense, but also in the same right line in a physical one. This quality, united with the direct motion of the brass bars, renders the motion of the globes simple and uniform, and therefore the effect (depending on such simple and direct causes) is regular and certain.

The common balance, when in motion, causes the weights to fly off or recede from the axis of the balance, and this flying off will increase and diminish with the arch of vibration in the balance: for, as there is nothing to brace the rim at the extremity of which the weight is suspended; as the arch of vibration increases, the weight and rim are thrown outward as much as the centrifugal force of the weight exceeds that of the elasticity of the rim. And as the arch of vibration diminishes, and consequently the centrifugal force, the weight is thrown inward by the elasticity of the rim.

My weights or spheres are firmly braced in every degree of temperature, and consequently not influenced in the smallest degree by any change in their centrifugal forces; therefore, in every respect, this balance may be considered as permanent.

The great difficulty in constructing a balance, and in applying the direct expansion of metals, is to contrive it so as that it shall preserve its equilibrium in every degree of temperature, and also admit of having all its parts made perfectly equal and similar by mechanical means. Both these important problems I have solved, by the introduction and application of a different principle from any yet used in the construction of the balance of a time-keeper; and I am fully satisfied, from a variety of experiments which I have made, that by this total change of system, I have made a higher step towards the perfection of time-keepers, than

than has been effected by any other means that have come within my knowledge.

The real respect which I have for the Society of Arts, will not suffer me to offer any thing that I do not consider of the first consequence; if I am right, I may justly claim the attention of the Society. I have not any other thing (in my own opinion) so worthy of their notice as this *permanent balance*, whose merits I submit to their judgment.

I am, with every sentiment of respect,

SIR,

Your obliged and humble servant,

WILLIAM HARDY.

To CHARLES TAYLOR, Esq.
Secretary to the SOCIETY of ARTS, &c.

Feb. 28th, 1805.

DEAR SIR,

I TAKE the liberty to express my opinion of the compensation-balance, which Mr. Hardy has submitted to the consideration

consideration of the Society of Arts. I think it a very excellent contrivance: the following are some of the reasons which, I presume, will entitle it to the approbation of that respectable Institution.

First.—The invention of confining the flexure of the steel bar to a small part near the end is new, and no less remarkable for its ingenuity and simplicity, than for the steady effect it produces.

Second.—The whole combination is particularly firm; and as the workmanship depends upon faces which are either plain or turned in the lathe, it can very easily be manufactured without requiring uncommon skill in the workman.

Third.—As it has neither working surfaces of contact, nor joints nor levers, it will regularly obey the minute changes of temperature, and will not act by jerks or starts.

Fourth.—

Fourth.—In the expansion-bar consisting of two metals, connected longitudinally by soldering or otherwise, the differences of length between them, when heated or cooled, are found to produce a bending of the whole bar, which is more the thinner its component parts. At the very surface of contact, and at a considerable distance on each side of that surface in thick bars, the principal effect must consist in what workmen would call wire-drawing the one metal, and upsetting the other. It is reasonable to think that this process must affect the properties of a balance so constructed, and cause it to deviate in the course of time from its original adjustment. This objection to the common expansion-balance appears to be obviated in Mr. Hardy's invention. The flexure of the brass takes place through its whole length, in a regular manner, and is in quantity but small; and the flexure in the reduced parts of

the steel bar will be equally slight, if the thickness of that part be made to bear the same proportion to its length. Hence, and upon the whole, it may be concluded that when once it is adjusted, it will not alter, and that in all changes of temperature it will be similarly affected, and will return to its original figure whenever the first temperature is restored.

FIFTH.—Artists will probably consider it as a desirable property of the present instrument, that the adjustments for temperature being made in lines nearly parallel to the verge, will have no practical effect in deranging the adjustments for position.

I have the honour to be,
Dear Sir,
Your most obedient servant,
WILLIAM NICHOLSON.

Soho-square, March 7th, 1805.

To CHARLES TAYLOR, Esq.

A cer-

A certificate, dated March 6th, 1805, was received from Mr. Alexander Cumming, of Pentonville, stating that he had seen Mr. Hardy's expansion balance; that in his opinion it has considerable merit, and promises to act uniformly, steadily, and permanently.

Reference to the Engraving of Mr. Wm. Hardy's Permanent Balance, Pl. XIII. *Fig.* 5, 6; *expressing in inches and decimal parts of an inch, the dimensions of the several pieces.*

Fig. 5. A A. Two globes which slide on the cylindrical stems of two upright levers, and are fastened by screws, by which the effect of the expansion is increased or diminished.

C C. Two equal and similar screws, by which the watch is adjusted to mean time.

D D. The verge or axis of the balance.

 E E. The

E E. The combination of the steel bar with the brass bars.

Fig. 6. S S. The steel bar, whose

length is	1.600
Its breadth	0.232
Its thickness	0.032

B B. Two similar and equal

brass bars, in length each	1.470
In breadth each	0.078
In thickness each	0.032
Length of the two springs formed out of the steel bar	0.030

The

The SILVER MEDAL and TWENTY GUINEAS were this Session voted to Mr. JOHN PRIOR, of Nessfield, near Skipton-in-Craven, Yorkshire, for a LARUM applicable to POCKET WATCHES.

The following COMMUNICATION was received from him; an ENGRAVING of the LARUM is hereunto annexed, and a MODEL reserved in the Society's Repository.

SIR,

SINCE I had the pleasure of seeing you last, I have invented, and shall finish in a day or two, a machine, which by the means of a pocket watch will, without hurting its going, cause a larum to let go at any minute required.

A watch will do for it with any number of turns of the fusee, or which ever

way it is wound up. The whole machine has only one wheel in it, and its main spring wound up and stopped by a method entirely new, which will be very useful to watch-makers, clock-makers, and others.

I am, Sir,
Your humble servant,
JOHN PRIOR.

Nessfield, near Skipton-in-Craven, Yorkshire, April 21st, 1804.

To CHARLES TAYLOR, Esq.

SIR,

AS the Society for the Encouragement of Arts, &c. have been pleased to countenance some former works of mine, I have taken the liberty to send you a larum marked P, of my own invention and workmanship, which I hope you will have the goodness the first opportunity to lay before that Society

ciety for their inspection, as they perhaps may find it worthy of their consideration.

In constructing this machine, I have endeavoured to make it as simple as I could; so that by the assistance of a pocket watch, of any size, or any number of turns of the fusee, which ever way it is wound up, it will cause the larum to let go at any time required, without hurting the going of the watch.

In winding up the main-spring of this machine, I have used a method different from that of any other person, and which admits of its acting with considerably more power than where thicker pivots are used.

The discovery of stopping the main-spring when wound up without a fusee, I must beg leave to say, gives me a great deal of satisfaction; and will, I hope, be useful to my brother workmen.

To show with what ease a watch will turn the larum screw, I made the following experiment.

When the machine was wound up and the lever put upon the screw, I turned the axis of the screw while one of the pins which has a communication with the key when the watch is put to the larum, was parallel to the horizon; its distance from the centre of motion was one-eighth and three-fourths of an inch. I hung a slender thread upon the pin, with ten grains troy weight tied to it, which moved the screw.

This larum may be set a week beforehand, if the watch would go as long, by increasing the number of threads of the screw.

When a watch is made to wind up the contrary way, it is necessary only to take out the pin in the axis of the detent, and turn the lever the other side up, and then it will drop off at the other end of the screw to disengage the larum.

By taking notice at what hour you wind up your watch, and by winding it up again at twenty-four hours, you will ascertain

ascertain how many hours are contained in one turn of the fusee, the most common are four, five, six, hours for each turn. I have divided the common index into 120, which does for three concentric circles. That next the centre is for a watch fusee of four hours a turn; the next five, and the last six. While the hand of the larum passes over one of the divisions, it will be equal to two minutes to the four hours circle, two and a half to the five hours, and three minutes to the six hours circle, all shown by the same hand.

Before a watch is put to the larum, it must be fitted with a key that will not drop off when the watch is turned with the key-hole downward, something like that which I have sent; then hang up the watch by the pendant to the holder, which may be turned while the key end on the watch is opposite to the axis of the screw, and the face of the watch parallel to the plate.

Then

Then turn the sliding pieces any way, as may suit the watch in that situation, and screw it fast.

Supposing the watch is four hours in making a turn of the fusee, turn back the hand of the larum while one of the pins touches the pin in the watch-key, and if the hand is not at top, turn it back till it is. If the larum is required to go off in four hours, lift the lever into the first turn of the screw; if in five hours, turn back the larum-hand one hour; if in six hours, two back; if in seven hours, three back; and if in eight hours, do not turn it back, but put the lever into the second turn of the screw; and so for the rest.

I am, Sir,
Your very humble servant,
JOHN PRIOR.

Nessfield, near Skipton-in-Craven, Yorkshire,
May 10, 1804.

To CHARLES TAYLOR, Esq.

Reference to the Engraving of Mr. PRIOR'S *Larum. Plate* XIV.

Fig. 1 shows a bird's-eye view of the machine.

A, shows the position of the watch on the larum.

B. The spiral cylinder, fixed on the axis, and moved by a pin across a key placed on the fusee square of the watch.

C. The acting lever, one end of which lies upon the spiral, the other end is moveable upon an arbor D.

E, shows a notch cut in the arbor D. This notch is cut more than half through the arbor, in a situation opposite to a pin at F, in the middle of the rim of the larum contrate-wheel G. When the lever C falls off the cylindrical spire B, the notch E is moved to a situation so as to allow the pin F to pass through the notch which discharges the larum-hammer H, which works by

by pallets in the contrate-wheel G in the usual manner.

O. The barrel which contains the spring, the inner hand of which is connected with the same axis as the contrate-wheel.

K. The finger-piece which winds up the spring.

b, b, b. The three sliding pieces which hold the watch.

c, c. Two projecting pins, which are carried round by the pin *d*, which is fixed across the key fitted to the fusee.

Fig. 2, shows that side of the machine on which the watch is fixed.

a. The sliding piece, on which the pendant of the watch is hung.

b, b, b. The three sliding pieces which serve to adjust the watch, and hold it in such a position that the fusee square may be in a line with the axis of the spiral cylinder B, shown in *Fig.* 1.

I, is

I, is a ratchet-wheel, on the centre of which is a button or finger-piece K, to wind up the larum spring.

L. The click which works in the teeth of the ratchet-wheel.

H. The lower part of the arm of the hammer.

M. The bell, within which the hammer strikes.

N. The cock in which the pivot of the axis of the pallets acts, and to which the hammer is connected.

Fig. 3, shows a section of the ratchet-wheel and spring-barrel, which are screwed together, and move at the same time, but are kept in their place by two pieces *e*, *e*, which fit a groove in the barrel.

K. The button or finger-piece.

I. The ratchet-wheel.

P. The box for the spring.

R. The cap which covers the spring box.

V. The

V. The axis on which the main spring is wound.

Fig. 4. R. The cap, under which is the spring. On the edge of this cap, at S, is an indent to retain the spring when wound up.

T. A lever, with a hook at its end.

At the end of this lever, on a line with the hook, is a small piece of steel, which goes through a hole in the box, and presses upon the main spring; so that, when the main spring is wound up on the axis V, the hook is at liberty to fall into the way of the indent S, and is there stopped.

Under the lever T is a small spring, which presses it against the main spring within the barrel.

Fig. 5 shows the index of the larum; the outside circle of which is divided into 120 parts, which index serves for three concentric circles; that

Mr. John Prior's Larum for Pocket Watches.

Pl. XIV.

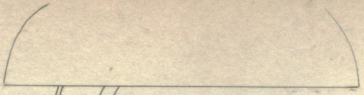


Fig. 3.

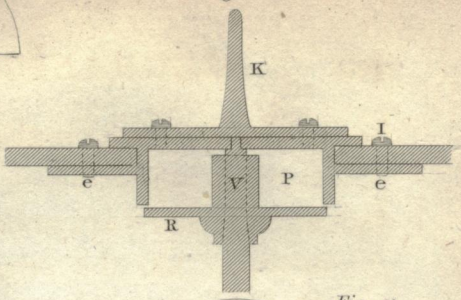


Fig. 5.

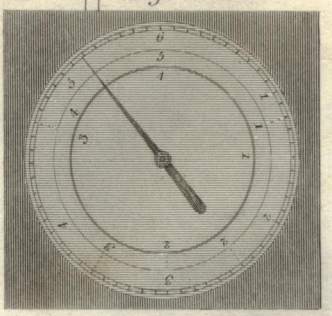
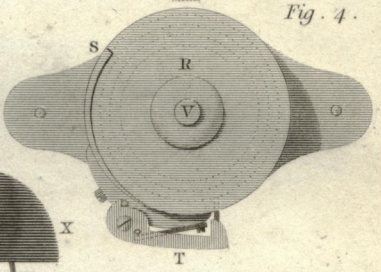


Fig. 4.



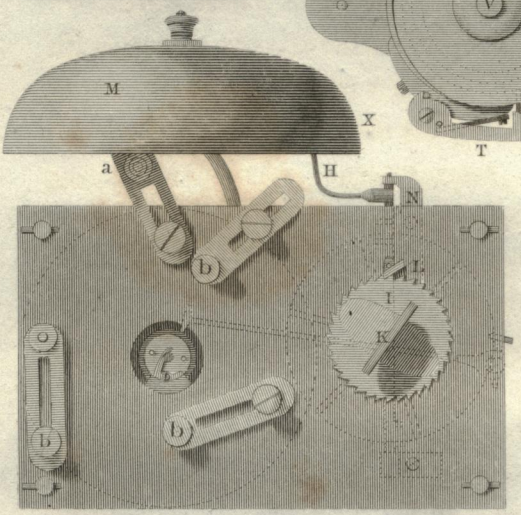


Fig. 2.

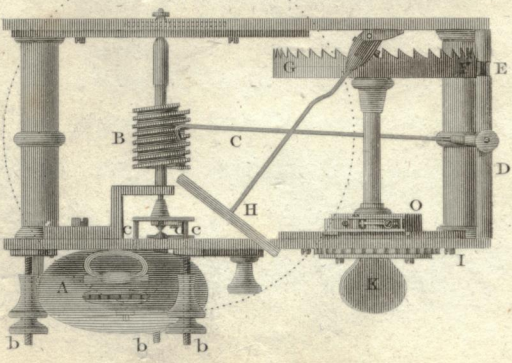


Fig. 1.

C. Varley del.

S. Porter sc.

that next the centre is for a watch fusee of four hours a turn, the next five, and the last six, as explained in the letter.